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THE TREMATODE GENUS OPISTHORCHIS

R. BLANCHARD, 1895

by

FRANKLIN D. BARKER

Professor of Zoölogy University of Nebraska.

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(Plates XVII-XX)

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INTRODUCTION

Up to the present time the genus *Opisthorchis* R. Blanchard, as far as known, has been represented in America by two species of Trematodes: *Distomum longissimum* var. *corvinum* S. and H., found in the biliary ducts of the Crows *(Corvus americanus* and *Corvus ossifragus)* in Maryland and the District of Columbia, which was described by Stiles and Hassall in 1894 and renamed *Opisthorchis speciosus* by the same authors in 1896, and a second species *Distomum felienum* Riv., found in the biliary ducts of the Cat *(Felis catus domestica)* and the Cayote *(Canis latrans* Say) in Nebraska and Iowa, which was described by Ward in 1895 and renamed *Opisthorchis pseudofelineus* by Ward in 1901. To these two known representatives of the genus should be added a new species, *Opisthorchis ovalis* mihi, found in the biliary ducts of the Soft-shell Turtles *(Trionyx spinifer* Lesson and *Trionyx muticus* Lesueur), where they occur abundantly in the Mississippi River, in Minnesota and Iowa.

The object of this investigation was to determine by a comparative study of the three American species the characters common to all, the distinctive characters of each and the degree of variation in these characters which may occur within a single species; also to determine the evidence, positive or negative, of a genetic relationship among the three forms, that is, to determine whether they represent three distinct species or three varieties of a single species modified by their life in three different hosts; finally by a comparative study of the American species and the European species the investigation undertakes to ascertain the specific rank of the form found in the Turtle. To this end all of the data on the species constituting the genus *Opisthorchis* has been collected and incorporated into a single paper for easy reference and comparative study.

Technique

The specimens of *Opisthorchis pseudofelineus* and *O. speciosus* had been killed, stained and mounted before coming into my possession. They had been fixed in 70 % alcoholic corrosive-acetic and stained in borax carmine, haemalum, or in cochineal.

The specimens of *O. ovalis* were for the most part obtained in a living condition from the smaller bile ducts of the liver of Soft-shell Turtles which had been killed only a short time before. The

specimens were placed in vials of physiological salt solution and violently shaken after the method devised by Looss (1901 : 309) for five minutes until thoroly relaxed and then placed between glass slips separated by strips of filter paper and quickly killed in a compressed condition by running hot corrosive-acetic solution between the slips. The material was stained in toto in borax carmine, Delafield's haematoxylin or haemalum, destained in acid alcohol, carried thru the alcohols between glass slips secured by a rubber band to keep them in a distended condition and mounted in xylol balsam.

DESCRIPTION OF THE AMERICAN SPECIES

Opisthorchis pseudofelineus (pl. XVII, fig. 4).

The following diagnosis of the characters of *Opisthorchis pseudofelineus* Ward, which differs slightly from that given by Ward (1895 : 241) and Stiles (1904 : 32), is based on the detailed study of more than one hundred specimens.

Shape of body, oblanceolate ; anterior end tapering and conical ; posterior end broad and rounding ; length of body 5 to 22 mm ; breadth of body across the acetabulum 0.75 to 1.5 mm ; breadth of body across the ovary 1 to 3 mm. *Oral sucker* terminal to subterminal in position, 0.24 to 0.541 mm wide by 0.19 to 0.45 mm long. *Pharynx* 0.12 to 0.26 mm long by 0.14 to 0.28 mm wide. *Œsophagus* 0.04 to 0.38 mm long. *Acetabulum* ventral, varying in situation from a position in the anterior fourth to the anterior seventh of the body ; acetabulum 0.14 to 0.31 mm in length by 0.17 to 0.32 mm in width. *Ovary*, orbicular, elliptical or oval in shape with margin smooth, undulating or lobed ; length 0.285 to 0.70 mm ; breadth 0.165 to 0.525 mm. *Receptaculum seminis* pear, oval or bag-shaped ; right or left postero-lateral of ovary ; shell gland diffuse and distinct. *Laurer's canal* prominent, right or left posterior and lateral to ovary. *Uterus* well developed, coils crowded. *Vitellaria* divided on each side into two regions (a third region opposite the ovary may occur), an antovarial region with from one to six acini and extending from the ovary cephalad to within 0.3 to 4.5 mm of the posterior margin of the acetabulum and a postovarial region with from one to three acini and extending caudad to within 0.3 mm of the anterior margin of the anterior testis to 4.6 mm poste-

rior to the posterior margin of the posterior testis ; each region of the vitellaria is provided with its own vitelloduct which passes caudad or cephalad toward the ovary, the vitelloducts uniting before or after reaching the ovary ; the break between the regions of the vitellaria varies in extent from 0.06 mm to 1.9 mm and in position from one half of the break being anterior to the anterior margin of the ovary, to the entire break being posterior to the anterior margin of the ovary. *Eggs* long ovals in shape, cap distinct with an opercular rim at junction of cap and egg body (pl. XVII, fig. 3.); length 0.0286 to 0.0357 mm by 0.014 to 0.0162 mm wide. *Testes* two in number, situated in the posterior fourth or fifth of the body, the posterior testis lying obliquely caudad to the anterior ; orbicular, oval or elliptical in shape ; margin smooth, undulating or 2 to 5 lobed. *Excretory reservoir* Y shape ; excretory canal sigmoid. *Intestinal cæca* extend to posterior end of body and are unequal in length. *Genital pore* at anterior margin of acetabulum (pl. XVII, fig. 1). *Skin* provided with minute needle-like spinelets on the anterior portion of body as far caudad as the ovary ; spinelets deeply embedded in cuticula (pl. XVII, fig. 2).

Habitat. - Biliary ducts of the domesticated Cat and a pet Coyote.

Distribution. - Nebraska and Iowa, U. S. A.

Opisthorchis speciosus (pl. XVIII, fig. 2,5 and 6).

The following description of *Opisthorchis speciosus* St. and H. differs somewhat from that given by Stiles and Hassall (1894 : 418), (1896 : 154), is more detailed and is based on the examination of a larger number of specimens, the number examined being seven, as many as it was possible to secure.

Body long and narrow gradually tapering toward the anterior end which is truncate ; posterior end broader and tapers suddenly back of the posterior testis to a bluntly or sharply conical end ; body slightly constricted at the level of the ovary and the acetabulum ; region anterior to the acetabulum very elongate. *Retrose spinelets* (pl. XVIII, fig. 5) embedded in the cuticula thickly cover the anterior region of the body as far caudad as the vitellaria, whence they are either scattered over the remainder of the body or are entirely absent. In three specimens the posterior portions of the intestinal cæca contained masses of spinelets which indicates that

they are easily shed with the cuticula and may be swallowed by the trematode. This seeming instabitity of the spinelets would also account for the presence of spinelets in different regions of the bodies of different specimens and indicates the occurence of spinelets over the entire body of the Worm under normal conditions. *Length of body* 7.6 to12.41 mm (12 to 29 mm St. and H.). *Width of body* across the acetabulum, 0.416 to 0.79 mm ; width across the ovary 0.666 to 1.332 mm ; oral sucker sub-terminal, 0.291 to 0.366 mm long by 0.291 to 0.357 mm wide ; acetabulum in the anterior third or anterior fourth of the body and measures 0.178 to 0.244 mm long by 0.178 to 0.244 wide. *Pharynx* 0.15 to 0.206 mm long by 0.131 to 0.188 mm wide. *Œsophagus* 0.15 to 0.30 mm long ; intestinal cæca extend to the posterior end of the body and are equal or unequal in length. *Testes* in posterior eighth of body, orbicular, oval or ovate in form with smooth, undulating or three to four-lobed margins ; anterior testis 0.432 to 1.615 mm long with a mode of 0.752 mm and 0.394 to 0.733 mm wide with a mode of 0.733 mm ; posterior testis 0.413 to 0.912 mm long with a mode of 0.846 mm and 0.394 mm to 0.733 mm wide with a mode of 0.733 mm. *Cirrus* and cirrus pouch absent. *Ovary* in anterior portion of the posterior fifth of the body, oval, ovate or elliptical in shape with a smooth or three lobed margin, 0.432 to 0.582 mm long, by 0.206 to 0.432 mm wide. *Receptaculum seminis* oval or bag-shape and one half as large as or equal to the ovary in size and lies posterio-lateral to the right or left of the ovary. *Shell gland* anterio-lateral to the right or left of the ovary, diffuse and distinct. *Laurer's canal* prominent, posterio-lateral and to the right or left of the ovary. *Uterus* very dense and coils close, frequently extending laterally over the intestinal cæca and even over the vitellaria. *Eggs* long ovals in shape, tapering toward the end with lid, lid distinct with definite opercular rim at union of lid with egg body (pl. XVIII, fig. 6) ; eggs measure 0.026 to 0.033 mm in length and 0.015 to 0.018 mm in width. *Vitellaria* divided into two distinct regions on each side, antovarial region extends cephalad to within 1.203 to 2.63 mm of the posterior margin of the acetabulum and is composed of from two (possibly five) to five (possibly six) indefinitely defined acini ; the postovarial region extends caudad to a plane situated at one fourth the width of the anterior testis posterior to the anterior

margin of the anterior testis or to the posterior margin of the posterior testis; the break between the two regions of the vitellaria varies from 0 to 0.846 mm and in position varies from being entirely anterior to the ovary to being entirely posterior; each region has its own vitelloduct which passes to the ovary forming a Y or V shaped duct; the genital pore is not prominent and lies at the anterior margin of the acetabulum. *Excretory canal* sigmoid winding between the testes.

Habitat. — In bile ducts of Crows, *Corvus americanus*, *Corvus ossifragus* and of Egret.

Distribution. — Maryland and District of Columbia, U. S. A.

Opisthorchis ovalis (pl. XVII, fig. 5 - 9)

The following description of *Opisthorchis ovalis* n. sp. is based on the examination of ninety-seven preserved and mounted specimens.

General *shape of the body* slender and oblanceolate, the anterior end tapering and bluntly conical, the posterior end broader and tapering slightly toward the end. There is a well defined narrower region or neck anterior to the acetabulum; length of body 6 to 14.32 mm; breadth of body across the acetabulum 0.342 to 0.81 mm; breadth of body across the ovary 0.45 to 1.373 mm. Small needle-like, retrose *spinelets* (pl. XVII, fig. 5) abundant over the anterior two-thirds of the body, being most abundant at the anterior end as far caudad as the acetabulum and becoming sparser until the region of the ovary is reached; in three specimens these spinelets were quite abundant over the entire body which indicates either a variation in their distribution or the presence of spinelets in the younger stages with a tendency to shed them in the older stages or the dissolution of the spinelets by the reagents used in the technique. *Oral sucker* subterminal in position, 0.198 to 0.36 mm long by 0.198 to 0.378 mm wide. *Pharynx* 0.108 to 0.150 mm long by 0.108 to 0.162 mm wide. *Œsophagus* 0.09 to 0.630 mm long. *Intestinal cæca* extend to posterior end of body and vary in length. In the majority of the specimens examined the *intestinal cæca* were distended by masses of fine granular food materials in which were embedded large numbers of the trematode's eggs, these having been taken in with the food. *Acetabulum* in the anterior fifth, sixth or

seventh of the body and measures 0.131 to 0.216 mm long by 0.131 to 0.225 mm wide. *Ovary* in the anterior end of the posterior half oft he body and a little to the right or to the left; shape oval, ovate or orbicular; margin smooth, rarely slightly undulating or crenate; length 0.198 to 0. 451 mm; breadth 0.198 to 0.360 mm. *Receptaculum seminis* posterio-lateral, right or left of the ovary, from two to four times the size of the ovary and pear or bag-shaped; shell gland antero-lateral to the ovary either right or left, diffuse and somewhat indistinct. *Laurer's canal* posterior to and right or left of the ovary and very distinct. *Uterus* medium well developed, of medium density with the uterine coils rather loose. *Vitellaria* divided on each side into two distinct regions (a third region opposite the ovary occurs in a few specimens), an antovarial region composed of from four to six distinct acini, extending cephalad to within 0 36 to 1.89 mm of the posterior margin of the acetabulum and a post-ovarial region composed of from two to five distinct acini (pl. XVII, fig. 9) extending caudad to the plane of the posterior margin of the anterior testis or to a plane 0.62 mm posterior to the posterior testis; each region of the vitellaria provided with its own vitelloduct which passes caudad or cephalad toward the ovary, the two ducts unite and form a V or a Y according as they meet after or before reaching the margin of the ovary; the break between the two regions of the vitellaria varies in extent from 0.414 mm to 3.1 mm and in position from the entire break being anterior to the anterior margin of the ovary to the entire break being posterior. *Eggs* are short ovals in shape (pl. XVII, fig. 8) 0.024 to 0.312 mm long by 0.014 to 0.019 mm wide; the lid is distinct but the opercular rim at the junction of the lid and the body of the egg is absent. *Testes* in the posterior third of the body, the posterior testis slightly oblique and posterior to the anterior testis; ovate or orbicular in shape, with margins smooth, undulating or rarely slightly lobed; size 0.36 to 0.99 mm long by 0.27 to 0.666 mm wide. *Excretory reservoir* lies near the posterior end of the receptaculum seminis and is indefinitely Y shaped; excretory canal passes caudad from the excretory reservoir in a slightly sigmoid course between the testes and ends in a median excretory pore at the posterior end of the body. *Genital pore* distinct and lies median, right or left of and on the margin of or anterior to the margin of the acetabulum (pl. XVII, fig. 7).

Habitat. — Bile ducts of Soft-shell Turtle.

Distribution. — Mississippi River in Minnesota and Iowa, U. S. A.

COMPARATIVE STUDY OF THE AMERICAN SPECIES

(pl. XVII, fig. 1-9 ; pl. XVIII, fig. 2, 5, 6).

A study of the comparative table (page 525) of the characters of the three species of trematodes under consideration reveals many characters common to all three, other characters common to two and still others peculiar to each species. The characters of the genus, such as the elongated body, with attenuated anterior end and broader posterior end, the size and relative position of the suckers, the sigmoid stem of the excretory system, the position of the genital pore and the absence of copulatory organs, the shape and position of the testes in the posterior portion of the body, the presence of Laurer's canal and the great development of the receptaculum seminis, the extent and position of the uterine coils anterior to the ovary, the development and extent of the vitellaria caudad to the acetabulum, all these characters are found to be common to the three species and may rightly be regarded as generic characters.

A comparative study of each character shows some interesting resemblances as well as distinctive features. *O. pseudofelineus* and *O. speciosus* have very much the same shaped body, differing from that of *O. oralis*, which is more slender. *O. pseudofelineus* is the largest of the three species, the length of the body and the width of the body across the acetabulum and the ovary being greater than that of the other two forms, *O. oralis* being the smallest of the three. Retrose, needle-like spinelets are found in the cuticula of all three forms, the spinelets being more deeply embedded in the cuticula of *O. pseudofelineus* and *O. speciosus* than in the cuticula of *O. oralis*, in which they stand out prominently (pl. XVII, fig. 2, 5 ; pl. XVIII, fig. 5). The seeming difference in the distribution of the spinelets is of little significance as their distribution varies in different individuals of the same species, depending on the age of the individuals or the condition of the cuticula.

Both the oral sucker and the acetabulum of *O. pseudofelineus* and *O. speciosus* are more nearly the same size and larger than those of *O. oralis* ; the oral sucker of *O. pseudofelineus* measuring 0.31 ×

0.38 mm, that of *O. speciosus* 0.29 × 0.35 mm and that of *O. oralis* 0.28 × 0.26 mm., the acetabulum in *O. pseudofelineus* measuring 0.26 × 0.24 mm, in *O. speciosus* 0 24 × 0.23 mm and in *O. oralis* 0.178 × 0.169 mm. The relative size of the oral sucker as compared with the acetabulum is however seen to be less in both *O. pseudofelineus* and in *O. speciosus*, the ratio being 2. 4 : 1. 9 : 1. 8 for *O. oralis*, *O. speciosus* and *O. pseudofelineus* respectively. The position of the acetabulum is peculiar to each species ; in *O. pseudofelineus* it is situated in the anterior fifth of the body, in *O. oralis* in the anterior sixth and in *O. speciosus* in the anterior third or fourth.

The pharynx is largest in *O. pseudofelineus*, almost circular in *O. pseudofelineus* and *O. oralis* and more oval in *O. speciosus*. A constant and striking character in *O. oralis* is the lenght of the œsophagus which measures 0.394 mm as compared with that of *O. pseudofelineus* which measures 0.24 mm and of *O. speciosus* which is 0.15 to 0.30 mm long ; the smallest form is seen to have the longest œsophagus which clearly indicates that there is no correlation between the size of the body and the lenght of the œsophagus.

The position of the ovary is peculiar to each species ; in *O. pseudofelineus* it is situated in the anterior portion of the posterior third or fourth of the body ; in *O. oralis* in the posterior half of the body ; and in *O. speciosus* in the posterior fifth of the body. This extreme posterior position of the genital organs in *O. speciosus* is one of the very noticeable distinctive characters of this species. The size, shape, and margin of the ovary differ slightly in each species ; the ovary is largest in *O. speciosus*, measuring 0 582×0.432 mm ; in *O. pseudofelineus* 0.365×0.265 mm ; and in *O. oralis* 0.338×0.282 mm ; the shape varies in each species from orbicular, in which the diameters are nearly equal, to elliptical, with one diameter two or more times the lenght of the other ; an oval shaped ovary is most constant in *O. pseudofelineus* and *O. oralis* and an ovate or egg-shaped ovary in *O speciosus* ; the margin varies from smooth to undulating and lobed in *O. pseudofelineus* and *O. speciosus* but is generally smooth in *O. oralis*. The size, shape and position of the receptaculum seminis varies in each species, in shape being pear, oval or bag-like ; in size varying from an equal size to two or three times that of the ovary in *O. pseudofelineus*, in *O. oralis* being from two to four times the size of the ovary and in *O. speciosus* only one

half as large as or equal to the ovary in size ; in *O. pseudofelineus* the receptaculum seminis lies to the right of the ovary in 56 per cent of the specimens examined, in *O. ovalis* it lies to the right in 65 per cent and in *O. speciosus* in 50 per cent.

The shell gland is diffuse in all three species, distinct in *O. pseudofelineus* and *O. speciosus* and indistinct in *O. ovalis*. Laurer's canal is very prominent in each species.

The density and closeness of the uterine coils vary in each species and these variations seem to be quite constant. The uterine coils of *O. speciosus* are very dense and close and frequently extend laterally over the intestinal cæca and in somes cases over the anterior portions of the vitellaria ; in *O. pseudofelineus* the coils are dense and close but rarely extend over the intestinal cæca : in *O. ovalis* the coils are only medium dense and loose and lie within the intestinal cæca.

The extent, number of acini, position and extent of the regional break of the vitellaria vary greatly in each species and in the different individuals of the same species. Three regions, antovarial, postovarial and a region opposite the ovary, occur in *O. pseudofelineus* and *O. ovalis*, and only two regions, antovarial and postovarial, in *O. speciosus*. In both *O. pseudofelineus* and *O. speciosus* the acini seem to have fused, espécially in the antovarial region, making it impossible to determine absolutely the number of acini ; in *O. ovalis* the acini are much more distinct and definite. In *O. pseudofelineus* the number of acini in the antovarial region of the vitellaria varies from one, which is probably the fusion of five acini, to six distinct acini, the mode for the acini being five in 65 per cent ; in *O. speciosus* the number varies from two (possibly five fused) to five (possibly six fused) with a mode of four (possibly five) in 37 per cent in *O. ovalis* the number of acini varies from four to six, the mode being five. In the postovarial region the number of acini varies from one (possibly two fused) to three with a mode of three in 58 per cent, in *O. pseudofelineus* ; in *O. speciosus* the number varies from one (possibly three) to three, with a mode of two (possibly three) in 37 per cent and in *O. ovalis* the number of acini varies from two to five, the mode being three in 75 per cent. The distinctness of the acini and the common occurence of four and even five acini (four occurs in 37 per cent and five in one

specimen) in the postovarial region is one of the distinctive characters of *O. oralis*. The extent, both cephalad and caudad, of the vitellaria is greatest in *O. ovalis*, in which it extends cephalad to within 0.752 mm of the acetabulum and caudad to the posterior testis, while in *O. pseudofelineus* the extent cephalad is to within 0.70 to 1.10 mm of the aeetabulum and caudad to the posterior testis and in *O. speciosus* the extent cephalad is to within 1.20 to 1.54 mm of the acetabulum and caudad to or anterior to the posterior testis. The position of the testes in the extreme posterior end of the body in *O. speciosus* however brings the extent caudad of the vitellaria much nearer to the posterior end of the body than in the other two species. The regional break between the antovarial and postovarial portions of the vitellaria is nost marked in *O. oralis*, the mode of its extent being 1.22 mm on the right side and 1.316 mm on the left side while in *O. pseudofelineus* the mode for the break is only 0.2 mm and in *O. speciosus* 0.282 mm .The extent of the regional break is greatest in the smallest of the three species, the mode for the break in *O. oralis* being from one third to one half as great as the maximum break for either of the other two species and six times as great as the mode for either of the other species. In *O. pseudofelineus* and *O. speciosus* the middle of the regional break is opposite the ovary in the majority of the individuals but in *O. oralis* more than one half of the break is commonly anterior to the margin of the ovary.

The position of the regional break and its great extent are two of the constant and distinctive characters of *O. ovalis*. The type of vitelloduct varies in all three species from the T type to the Y and V type, the V type predominating in all three species. Many of the variations in the vitellaria and vitelloducts that have been described as occuring in *O. pseudofelineus* (Barker, 1907 : 99) also occur in *O. oralis*.

In size and shape the eggs of *O. speciosus* and *O. pseudofelineus* are more nearly alike while the eggs of *O. ovalis* are distinctive in both particulars (pl. XVII, fig. 3, 8 ; pl. XVIII, fig. 6) ; the eggs of *O. oralis* are smaller measuring 0.0288 mm by 0.0168 mm and more oval in form with a less prominent lid than the other species ; in size the eggs of *O. speciosus* and *O. pseudofelineus* are very close, the eggs of the former measure 0.033 mm by 0.0165 mm and those of

the latter 0.0313 mm by 0.0156 mm ; their shape is also very similar, both being elongated ovals in outline having well marked lids with rims, the eggs of *O. speciosus* being the longer.

There appears to be a greater degree of variation in the size of the eggs of the same species than in the modes for the size of the eggs in the different species, for these data show that the size of the eggs in a single species may vary from 0.0071 to 0.0078 mm in length and from 0.0022 to 0.0052 mm in width but that the variation in the modes, for the size of the eggs in these three different species, is rarely greater than 0.002 to 0.004 mm in length and 0.0003 to 0.0012 mm in width. This same condition seems to prevail in the size of the oral sucker, pharynx, œsophagus, acetabulum, ovary, testes, extent of the vitellaria caudad and cephalad, and the extent of the regional break of the vitellaria, for in all of these structures the variation in size is greater in a single species than the variation in the modes for the size and extent of these structures in the three different species. From the study of these three species at least it would appear that a comparatively small variation in the modes for the size of various structures may accompany distinct species and in the case of the size of eggs this variation may be very small indeed.

The genital pore is situated at or silghtly anterior to the anterior margin of the acetabulum and is more distinct in *O. ovalis* than in the other species. The testes are situated in the posterior portion of the body in the three species, the extreme posterior position of the testes in *O. speciosus* being very marked. The size, shape and margin of the testes vary greatly in all three species, the shape and size being most constant in *O. ovalis*, 76 per cent having oval-shaped testes with smooth margins. Orbicular, ovate and elliptical shapes with undulating and three to five lobed margins occur in all three species. The anterior testis is left and the posterior right in 56 per cent of the specimens of *O. pseudofelineus*, in 70 per cent of the specimens of *O. ovalis* and in 50 per cent of *O. speciosus*. Situs inversus affecting the shell gland, Laurer's canal, receptaculum seminis and the testes is seen to occur very commonly in these three species of Trematodes. The constant oval shape and smooth margins of the reproductive organs, the ovary and testes, is one of the most distinctive characters of *O. ovalis*. The excretory

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TABLE I. — COMPARATIVE TABLE OF SPECIFIC CHARACTERS OF

CHARACTER	*O. PSEUDOFELINEUS*			
	mm Min.	mm Max.	mm Mode	0/0
1. Shape of body		oblanceolate		
2. Shape of anterior end		tapering, conical		
3. Shape of posterior end.		broad, rounding		
4. Spines (needle-like)		cover ant. 2/3 of body		
5. Length of body.	5	22	16	15
6. Breadth of body across acet	0.75	1.5	1.25	56
7. Breadth of body across ovary	1.0	3.0	2.0	40
8. Oral sucker, position		terminal to sub-terminal		
9. Oral sucker, length	0.19	0.45	0.31	12
10. Oral sucker, width	0.24	0.341	0.38	16
11. Pharynx, length	0.12	0.26	0.23	23
12. Pharynx, width	0.14	0.28	0.21	18
13. Œsophagus, length	0.04	0.38	0.24	15
14. Acetabulum, position	Ant. 1/4	1/7	1/5	46
15. Acetabulum, length	0.14	0.31	0.26	25
16. Acetabulum, width	0.17	0.32	0.24	15
17. Ovary, shape	orb.	ellip.	oval	44
18 Ovary, margin	sm'th	lobed	und	34
19. Ovary, length	0.285	0.70	0.365	17
20 Ovary, width	0.165	0.525	0.265	12
21 Receptaculum, shape	pear	oval	bag	80
22. Receptaculum, position.	R	L	R	56
23. Shell gland		diffuse, distinct		
24 Laurer's canal		prominent		
25. Laurer's canal, position	L	R	L	56
26. Uterus		dense, coils close		
27 Vitellaria, regions, right	2	3	2	99
28 Vitellaria, regions, left	2	3	2	94
29. Acini, anterior, right	1 (5)	6	5	65
30. Acini, anterior, left	1 (5)	6	5	70
31. Acini, posterior, right	2	3	3	52
32. Acini, posterior, left.	1 (2)	3	3	58
33 Vitellaria, extent, ant. right.	0.3	4.5	1.40	24
34. Vitellaria, extent, ant. left	0.3	3 7	0 7	19
35. Vitellaria, extent, post. right	to A. T.	+ P. T.	to P. T.	28
36. Vitellaria, extent, post. left	0.3 — A. T.	4.6 + P. T.	to P. T.	22
37. Vitellaria, break, extent, right	0.08	1.3	0.2	33
38. Vitellaria, break, extent, left	0.06	1.9	0.2	26
39. Vitellaria, break, position, right	1/2 ant.	4/4 post.	opp.	49
40. Vitellaria, break, position, left	1/3 ant.	4/4 post.	opp.	55
41 Eggs, length.	0 0286	0.0357	0.0313	51
42. Eggs, width.	0.014	0.0162	0.0156	65
43. Eggs, shape		long, oval		
44. Eggs, lid		distinct, rim present		
45. Genital pore.		indistinct		
46. Genital pore, position	M. R.	L. ant.	marg. acet.	
47 Vitelloduct, type, right.	T	Y	V	52
48 Vitelloduct, type, left	T	Y	V	50
49. Testis, anterior, shape	orb.	ellip.	oval	45
50. Testis, anterior, margin	sm'th	5-lobe	2-lobe ; und	23
51. Testis, anterior, position	R	L	L	56
52. Testis, anterior, length.	0.425	1 20	1.10	12
53 Testis, anterior, width	0.265	0 98	0.505	11
54. Testis, posterior, shape.	orb	ellip.	oval	55
55 Testis, posterior, margin	sm'th	5-lobe	3-lobe	30
56. Testis, posterior, position	R	L	R	56
57. Testis, posterior, length.	0.425	1.36	1.065	14
58. Testis, posterior, width.	0.265	0.98	0.505	11
59 Excretory, reservoir, shape		marked Y		
60. Excretory canal, shape		marked sigmoid		

EXPLANATION OF THE ABBREVIATIONS USED IN THE PRECEEDING TABLE. — *Acet.*, acetabulum ; *ant.*, an left ; *L.,L. ant.*, left and anterior ; *marg.*, margin ; *max.*, maximum ; *min.*, minimum ; *mm.*, testis ; +/+, posterior to ; + *1/2.*, posterior to middle of ; *R.*, right ; *sm'th.*, smooth ; —, sligh

HE THREE AMERICAN SPECIES OF THE GENUS OPISTHORCHIS

	O. OVALIS			O. SPECIOSUS			
n n.	mm Max.	mm Mode	0/0	mm Min.	mm Max.	mm Mode	0/0
	slightly oblanceolate tapering, bluntly conical tapering, conical ant. 2/3 or entire body				slightly oblanceolate tapering, truncate tapering, conical ant. 2/3 or entire body		
	14.32	12	9	7.6	12.41	—	
342	0.81	0.583	50	0.416	0.79	0.66	40
35	1.373	0.999	20	0.666	1.332	1.082	25
	sub-terminal				sub-terminal		
98	0.36	0.282	16	0 291	0 366	0.291	50
98	0.378	0.263	20	0.291	0.357	0 357	75
08	0.150	0.131	65	0.150	0 206	0.206	50
08	0.162	0.122	37	0.131	0.188	0.150	50
99	0.63	0.394	13	0.150	0.30	—	—
1/5	1 7	1 6	52	1/3	1/4	1/3 and 1/4	50
31	0 216	0.178	27	0.178	0.244	0 244	50
31	0.225	0.169	27	0.178	0.244	0 234	50
o	ovate	oval	61	oval	ellip.	ovate	37
th	cren.	sm'th	90	sm'th	3-lobe	lobe and sm'th	37
98	0 451	0 338	20	0.432	0.582	0.582	50
98	0 36	0 282	27	0.206	0.432	0.432	37
ar	bag	bag	40	bag	oval	bag	90
	L	R	65	R	L	L and R	50
	diffuse, indistinct prominent				diffuse, distinct prominent		
	L	L	70	R	L	L and R	50
	medium dense, coils loose				very dense and close		
	3	2	99	2	2	2	100
	3	2	99	2 (5)	2	2	100
	6	5	79	2	5 (6)	4 (5)	37
	6	5	75	2 (5)	4 (6)	4 (5)	37
	4	3	70	1 (3)	3	2 (3)	37
	5	3	80	1 (3)	3	2 (3)	37
36	1.89	0.752	15	1.541	2.63	1.541	40
576	1.62	0 846	23	1.203	2.44	1 203	40
A. T.	0.62 — — P. T.	to P. T.	20	— 1/2 A. T.	1/6 P. T	to P. T.	50
A. T.	0.47 — — P. T.	+ 1/2 P. T.	21	1/4 A. T.	- 1/3 P. T.	to 3/4 P. T.	25
414	3.1	1 22	12	none	0.846	0 282	25
576	2.914	1 316	14	none	0 714	0 1316	25
ost.	4/4 ant.	1/2 ant.	26	3/4 ant.	4/4 post.	op. OV	60
ost.	4/4 ant.	1/2 ant.	27	4/4 ant.	4/5 post.	op. OV	37
024	0 0312	0.0288	47	0 026	0.0338	0.033	42
014	0 0192	0 0168	33	0 015	0 018	0 0165	60
	short, oval distinct, rim absent distinct				long, oval distinct, rim present indistinct		
R.	L. ant.	marg. acet		ant.	marg. acet		
	V	V	50	V	V	V	75
	V	V	47	V	V	V	62
b.	ovate	oval	76	orb.	ovate	oval	50
th	3-lobe	sm'th	74	sm'th	3-lobe	sm'th	50
	L	L	70	R	L	R and L	50
36	0.99	0 601	23	0.432	1.015	0 752	25
27	0.666	0 488	27	0.394	0.733	0 733	25
b.	ovate	oval	77	orb.	oval	oval	62
th	2-lobe	sm'th	63	sm'th	4-lobe	und	50
	L	R	65	R	L	L and R	50
306	0.752	0 601	21	0.413	0.912	0 846	37
27	0 658	0.50	26	0.394	0.733	0.733	37
	indefinite Y slightly sigmoid				indef. to marked Y marked sigmoid		

or; *A. T.*, anterior testis; — *A. T.*, anterior to ant. testis; *cren.*, crenate; *ellip.*, elliptical; limeter; *M. R.*, median and right; *opp.*, opposite; *orb.*, orbicular; *post.*, posterior; *P. T.*, posterior ; *und.*, undulating.

reservoir is distinctly Y shape and the excretory canal markedly sigmoid in both *O. pseudofelineus* and *O. speciosus* but indefinitely Y shape and only slightly sigmoid in *O. oralis*.

Wherever in this comparative study of characters the sizes of parts have been compared the mode or mean measurement has been used. The percentage of constancy in *O. speciosus* is not as reliable as is the other species owing to the small number of specimens available for examination.

SPECIFIC CHARACTERS AND VARIATIONS OF THE AMERICAN SPECIES.

In summarizing the distinctive characters peculiar to each of these three species we find the following characters distinctive for *O. pseudofelineus* : general shape of body, size of body, both length and breadth, size of pharynx, position of acetabulum, density and closeness of uterine coils, size and shape of eggs, and the size and position of the testes. For *O. speciosus* we find the distinctive characters about the same as for *O. pseudofelineus* but fewer in number as follows ; general shape of body, breadth of body, position of acetabulum, position of ovary and testes, density and closeness of uterine coils, indefiniteness of acini,and the size and shape of the eggs.

O. pseudofelineus and *O. speciosus* seen to have more characters in common and the distinctive characters differ in degree rather than in kind. *O. oralis* possesses a larger number of distinctive characters which also differ in kind from those of the other two species. The distinguishing characters are as follows ; shape of body, length and breadth of body, size of oral sucker, size of pharynx, length of œsophagus, shape of ovary and testes, indistinctness of shell gland, moderate density and looseness of uterine coils, distinctness of acini, number of acini in postovarial regions of the vitellaria, extent caudad of the vitellaria, large extent and anterior position of regional break, size and shape of eggs, distinctness of the genital pore and the indefinite shape of the excretory reservoir and canal.

These characters are numerous and distinctive enough both in kind and degree to be considered sufficiently specific to place this form in a class by itself and to warrant the creation of a new species. As has been previously stated, of all these characters the oval shape of the ovary and the testes is one of the most constant and

peculiar to this form. This feature suggested the name *ovalis* as being both a diagnostic and an appropriate name for this new species.

In the previous discussion of the distinctive characters of these three species reference has already been made to the different and widely separated hosts which harbor these forms, which fact by itself according to Looss (1899 : 677) would constitute a specific character of sufficient value to warrant the creation of a separate species for each form. The finding of this new species of Trematode increases both the biological and the geographical distribution of the genus *Opisthorchis*.

COMPARISON OF THE AMERICAN AND EUROPEAN SPECIES.

A comparison of the American species of the genus *Opisthorchis* with the European species of that genus shows a special resemblance of these forms to three of the European species namely, *O. lancea* (Dies), *O. interruptus* Braun and *O. noverca* Braun.

Opisthorchis lancea (pl. XVIII, fig. 4).

Weski (1900 : 579) describes *O. lancea* as follows :

Body lanceolate, divided into neck and trunk regions ; anterior end conical and posterior end distinctly tapering ; length 5.5 to 12.5 mm ; greatest width 1 to 2.8 mm ; width of neck just anterior to the acetabulum 0.75 to 1.97 mm ; margin of neck undulating, margin of trunk ruffled with notched constrictions. *Oral sucker* subterminal, oval, 0.33 to 0.36 mm by 0.51 to 0.66 mm ; smaller than the acetabulum. *Acetabulum* at posterior portion of anterior third of body ; circular in shape, 0.51 to 1.2 mm in diameter. *Præpharynx* absent ; pharynx muscular followed by a short œsophagus which divides into two intestinal cœca which are straight in the neck region but undulating in the trunk region and extend to the extreme posterior end of the body, ending blindly. *Lateral excretory canals* small, lying one on each side lateral to intestinal cœca. *Excretory bladder* distinctly Y shape, its form varying with the amount of its contents, main stem sigmoid, winding between the testes, passing between the intestinal cœca and opening at tip of posterior end. *Testes* orbicular, anterior left and sometimes four lobed, posterior right and five lobed, if lobed. *Vas deferens*, covered by coils of the uterus, passes anterior over the acetabulum and opens into the genital atrium in the median line a little anterior to the acetabulum. *Cirrus* and cirrus pouch absent.

Receptaculum varies in shape, generally spindle shape (*spindelförmig*) and generally lies at the base of the right excretory branch, caudad and to the right of the ovary. *Shell* gland indistinct. *Ovary* biscuit shape

(*bisquitförmig*) ; uterine coils extend from ovary to acetabulum and lie between the intestinal cœca. End of uterus passes dorsal and to the right of the median line over the acetabulum opening into the genital atrium. *Eggs*, oval 0.029 to 0.033 mm long by 0.012 to 0.014 mm wide. *Vitelline glands* paired lying laterally between the intestinal cœca and the sides of the body ; they extend from a plane posterior to the acetabulum, equal to the diameter of the acetabulum, caudad to the end of the intestinal cœca. *Vitellaria* composed of small transversely placed acini, arranged in groups, eight groups on each side divided into two distinct regions by a break between the fourth and fifth groups ; the groups of each region being connected by a median longitudinal canal, the union of the canals from each region forming a transverse vitelline duct which passes to the ovary.

A comparison of the characters of *O. lancea* with those of the American species reveals some interesting resemblances and distinctive features. The shape of the body is distinctive, the anterior end resembling that of *O. pseudofelineus*, but the posterior end that of *O. speciosus* ; in the lenght of body it resembles the smallest of the American species, *O. ovalis*, but in width the largest, *O. pseudofelineus*. The size of the oral sucker is distinctive, being larger than that of the American species ; the position of the acetabulum comforms to that of *O. speciosus*, but its enormous size is quite distinctive, being four to five times as large as the acetabulum of the three American forms. The excretory bladder is more markedly Y shape, and the reproductive organs much smaller in comparison to the size of the body than in the American species. The development and looseness of the uterine coils and the number of the acini or groups in the postovarial region of the vitellaria resemble the conditions found in *O. ovalis* ; the extent of the vitellaria cephalad simulates that in *O. pseudofelineus* but the extent caudad is greater than that in any of the three American forms.

The eggs are long and narrow, as long as those of *O. speciosus*, but from 0.001 to 0.003 mm narrower. The regional break of the vitellaria appears from Weski's figure (pl. XVIII, fig. 4) to be about the extent and the position of that in *O. pseudofelineus*. *O. lancea* is also found in a different host « *Delphinus Tacuschi* » (*Steno tucuxi* Gray) from any in which the American forms are found.

Habitat. — Male *Delphinus Tacuschi* (*Steno tucuxi* Gray).

Distribution. — Barra do Rio Negro.

Opisthorchis interruptus (pl. XVIII, fig. 1)

The following description of *O. interruptus* is given by Braun (1902 : 5).

Body flattened, ligulate (band form), posterior end wider than anterior, 7 to 8 mm long, 0.5 mm wide across acetabulum, 0.7 mm wide across testes ; posterior end more or less pointed ; sides of body wavy, from acetabulum to testes due to arrangement of muscles ; no sharp distinction between neck and body. *Oral sucker* subterminal 0.25 × 0.26 mm. *Acetabulum* circular or oval 0.135 mm in diameter and 1.3 mm posterior to oral sucker. *Pharynx* 0.104 mm × 0.125 mm wide. *Œsophagus* about the length of the pharynx. *Intestinal cæca* reach to posterior end, one branch being longer than the other.

Posterior testes 0.7 to 0.8 mm from posterior end. Testes not equal in size or similar in appearance, the posterior testis orbicular and slightly lobed and somewhat larger than the anterior testis, anterior testis clearly four lobed. Excretory canal S form. *Receptaculum seminis* posterior and lateral to ovary, round or pear shape and smaller than the testes. *Ovary* in median line lying transversely, oval in form, long diameter equal to testes.

Uterus anterior to ovary in close transverse coils ; genital pore close to the acetabulum. *Cirrus* and cirrus pouch absent ; eggs brown, 0.023 × 0.01 mm. *Vitelline glands* begin posterior to acetabulum, a distance equal to that which separates the acetabulum and the oral sucker, and extend back to the posterior testis. Most characteristic is a constant break in the line of vitelline groups 0.6 mm long, on either side of the body in the region of the ovary and receptaculum. *Vitellaria* could not be made out in *Alcedo virescens*. Other organs and eggs same as in *Ardea viridirufa*.

Habitat. — Intestine of *Ardea virescens* and *Alcedo viridirufa*.

Distribution. — Brazil.

When compared with the American species *O. interruptus* is seen to be a smaller form, the oral sucker, acetabulum, pharynx, œsophagus, ovary, receptaculum, testes and the eggs are all smaller than those same structures in the American form. *O. interruptus* most closely resembles *O. pseudofelineus* in the position of the acetabulum which is in the anterior fifth of the body, in the extent cephalad of the vitellaria and also in their extent caudad, in the lobed margin of the testes and the sigmoid course of the excretory canal. In general appearence *O. interruptus* simulates *O. ovalis* and more especially in the following characters : the indistinctness of the shell gland, the indefiniteness of the anterior end of the excre-

tory reservoir, the slight density and looseness of the uterine coils, the distinctness of the acini or groups of the vitellaria and also the number of groups in the postovarial region and more particularly in the extent, 0.6 mm, and constancy of the regional break separating the antovarial and postovarial regions of the vitellaria. The seeming complete absence of spinelets and the different hosts are also distinctive characters.

Opisthorchis noverca (pl. XX, fig. 1-3).

The following description of *Opisthorchis noverca* Brn. is the original description given by Mc Connell (1876 : 344 and 1878 : 476) and differs somewhat from that given by Braun (1908 : 170) and Stiles (1904 : 33.)

Body lanceolate, anterior and posterior extremities pointed, the latter obtusely. Surface covered with minute spines or hairs. Average lenght 3/8 (three-eighths of an inch) ; average breadth 1/10.

Ventral sucker slightly smaller than oral. Reproductive papilla or genital orfice placed a little above and to one side of the former. *Alimentary canal* double and unbranched. *Uterine folds* and ovary placed in the median line, and above the male generative organs, the latter consisting of two very distinct globular bodies or testes. *Ova* of the usual type, i. e. oval in outline, having a double contour, and granular contents ; average length, 1/750 of an inch, average breadth, 1/1333, of an inch.

Only two or three specimens of this size 1/4 of an inch were found and these showed evidences of immaturity, a few were also found 1/2 in length.

Habitat. — Bile ducts and gall bladder of Man.

Distribution. — India.

The following characters based on the drawings given by McConnell (1876 ; 344, fig. 1-3) might be added to the foregoing description.

Acetabulum between first and second anterior ninths of body. *Pharynx* globular, larger than acetabulum. *Œsophagus* very short or absent. *Intestinal cæca* extend to posterior ninth of body. *Testes* in posterior third of body, the one obliquely behind the other, the anterior rounding, the posterior slightly three lobed. *Ovary* slightly posterior to middle of body and slightly three lobed. *Uterine*

coils loose. *Vitellaria* extend from the level of the acetabulum to the middle of the posterior testis ; vitelline ducts Y shape, vitellaria divided into two regions, break in line of acini indefinite. *Excretory bladder* Y shape, main stem very slightly sigmoid. Cirrus pouch, receptaculum seminis and Laurer's canal not shown. Laurer's canal and the receptaculum seminis were undoubtedly overlooked or possibly the large three lobed median body represents both the ovary and the receptaculum seminis.

The rather meager description and the indefinite drawings of *O. noverca* make a detailed comparison with other species impossible.

In general it seems to be about the same in lenght as *O. oralis* but is twice as broad ; the slight development of the uterus, the thickly set spinelets and the extent of the vitellaria cephalad simulate *O. oralis*. The width of the body, the indistinctness of the groups of the vitellaria and the shape of the reproductive organs are more like the conditions found in *O, pseudofelineus* and *O. speciosus*. The figure given by Mc Connell (1876 : fig. 1) (pl. XX, fig. 1) does not show any division by a break of the vitellaria into two regions, but the Y shape vitelline ducts with one branch passing cephalad and the other caudad are very distinct and it is quite probable that a regional break in the line of the groups of the vitellaria does occur and that the figure is either that of a specimen in which a variation in the extent of this regional break occurs, as is frequently found in *O. pseudofelineus* (Barker, 1907 : 102) or the vitellaria have not been accurately portrayed. The eggs seem to be larger than those of the American species, the size given 0.034 × 0.019 mm for *O. noverca* being the maximum size for the eggs of *O. pseudofelineus*.

Lewis and Cunningham (1872 : 168) first described a Trematode found in the bile ducts of Pariah Dogs in India and classified it as *Distoma conjunctum* Cobbold. A few years later McConnel (1876 : 343 and 1878 : 476) found Trematodes in the bile ducts and gall bladder of two Mohammedans who died in Calcutta and classified these as *Distoma conjunctum* Cobbold, considering them to be the same species as that found by Lewis and Cunningham in the Pariah Dogs.

Stiles and Hassall (1894 : 430) first pointed out the dissimilarity between the forms found by Lewis and Cunningham and McCon-

nell and Cobbold's form and suggested the probability that these forms were at least two distinct species. Looss (1899: 565) placed Cobbold's *Distoma conjunctum* in the genus *Metorchis*, while Lewis and Cunningham and McConnell's forms were left in the genus *Opisthorchis*.

Braun (1903: 164) gave the name *novercа* to McConnell's form, since the two different species could not bear the same specific name *conjunctum*.

It has been generally assumed that the forms found by Lewis and Cunningham and McConnell were the same species, namely *Opisthorchis novercа* Braun.

A careful comparative study of the original descriptions and drawings (Lewis and Cunningham, 1871: 168, fig. 1-4; McConnell, 1876: 344, fig. 1-3) of these two forms has convinced me that they represent two distinct tho perhaps related species. The differentiating characters which have led to this conclusion are shown in the following comparative table.

Characters	Lewis et Cunningham's form	McConnell's form
Length	6.36 mm.	9.52-12.7 mm.
Width × acetabulum	1.27 mm.	1.33 mm.
Width × ovary	2 mm.	3 mm. average 2.54 mm.
Position of acetabulum	bet. 1" et 2" ant. fifths.	bet. 1" et 2" ant. ninths.
Acetabular papilla	very prominent.	not prominent.
Position of ovary	beg. of. post. third.	beg. of post. half.
Extent of vitellaria, cephalad.	slightly post. to acetab.	level of acetab.
Extent of vitellaria, caudad	middle of ant. testis.	middle of post testis.
Type of vitellaria	one region.	two regions.
Position of testes	posterior third.	posterior third.
Shape of testes	globular -smooth.	slightly lobed.
Uterine coils	well developed.	poorly developed.
Eggs, length	0.0216-0.025 mm.	0.0338 mm.
Eggs, width	0.0116-0.013 mm.	0.019 mm.
Habitat	bile-ducts of Dogs.	bile-ducts of Man.

The difference in the size of these forms was recognized by McConnell and attention directed to it in the following sentence: « The only point of note is that the average length of these Flukes is greater than that of the same species found by the authors (Lewis and Cunningham) above referred to » (McConnell 1876: 344). And later this difference is again alluded to in the following sentence: « I have only to remark, that these fresh Distomata are

— as noticed in my first case — somewhat larger than the original entozoon discovered by Cobbold, being fully 3/8 inch in length, and several 1/2 inch as against 1/4 inch, the average size of the latter. » (McConnell 1878 : 476).

As shown by various authors (Looss, Braun, Barker), a constant difference in size cannot be attributed to a difference in the size of the final hosts.

Of the characters given in the preceding table the difference in the habitat, the position of the acetabulum, the size of the eggs, the development of the uterus, the extent of the vitellaria and the type of the vitelline glands are the most important. The difference in the extent and especially the difference in the type of the vitelline glands would, according to the revision of the genus *Opisthorchis* proposed in the present paper, place Lewis and Cunningham's form in the genus *Opisthorchis* and Mc Connell's form in the new genus *Amphimerus*.

This comparison, as previously stated, is necessarilly based on the drawings of the authors and needs to be verified by a careful comparative study of the original specimens. If such a study substantiates these differences, they are certainly sufficient in number and degree to warrant the separation of the two forms and to class Lewis and Cunningham's form as a separate species. I would suggest the name *Opisthorchis caninus* for Lewis and Cunningham's form.

The specific diagnosis, based on the drawings and meagre description of the authors, of *Opisthorchis caninus* is given under the « Synopses of the species constituting the genus *Opisthorchis* », page 542.

RELATIONSHIP OF THE AMERICAN SPECIES

A comparative study of the characters of the three american forms reveals certain striking superficial resemblances and a more detailled study of their characters emphasizes these close resemblances. Looss (1899 : 677) in his discussion of the identity of *O. geminus* Lss. and *O. tenuicollis* (R) raises a very interesting and important question in thefollowing words : « soll man die Gesammtheit der sich so ähnlichen Formen auffassen als eine grosse Anzahl von Arten, die in specifischen Wirthen leben, sich aber in ihrem Bau zum Theil nur recht wenig von einander unter-

scheiden, oder handelt es sich bei ihnen um nur wenige Arten, die aber die Bedingungen für ihre Entwicklung in den verscheidenartigsten Wirthen finden und dabei kleine Veränderungen in ihrem innern Bau annahmen. »

This same question might well be raised in regard to the close resemblance of these american species. The resemblance in the characters of many organisms is attributed to and has been experimentally proven to be due to the common ancestry of the similar forms. Can this resemblance among these three species of Trematodes likewise be attributed to their origin from a common ancestral type? To quote from Looss (1899 : 677) again : « Eine Lösung der Frage dürfte, wie die Verhältnisse gegenwartig liegen, nur durch das Futterungs experiment zu erwarten sein. » In the absence of any knowledge as to the life history of these forms and the lack of experimental data regarding the effect of different hosts on the same species of parasite, our discussion of the causes of the striking resemblance in these forms and the possible factors, with their relative influence, which may be operative must for the present be conjectural.

It may not be out of place, however, to briefly consider or to suggest some of the factors that might operate to produce slight changes from a common ancestral form. The source of infection would probably be the same in each case and this is not an impossibility in the case of the three hosts, namely, the Cat, Crow and Turtle, of the three parasites under consideration for all of these hosts are known to eat Fish, Crustacea and Molluscs, any of which might be an intermediate host. All three species of parasites are found in the same organ, namely, the liver, of their respective hosts.

The difference in the size of the parasites might be attributed to the difference in the size of the livers of the three different hosts, but this is evidently not the case for some of the specimens of *O. pseudofelineus* found in the Cat are longer by 2 mm and broader than the one specimen found in the Coyote and the specimens of *O. speciosus* found in the Crow are larger than those of *O. ovalis* found in the Turtle, though the liver of the Turtle is several times larger than that of the Crow. All three forms being found in the biliary ducts of the liver, and in the living specimens

of *O. pseudofelineus* and *O. oralis* the digestive tracts being filled with a reddish yellow fluid, it is probable that the bile forms a large part of the food for the three forms. The bile, however, would undoubtedly differ considerably, both in its density and composition in the different hosts and this might act as a differentiating factor.

The most interesting difference in the three hosts of these Trematodes is the difference in the temperature of the blood. The extremes in blood temperature are represented by that of the Turtle on the one hand and that of the Crow on the other hand, while the blood temperature of the Cat and Coyote is between. Whether or not this difference in blood temperature operates and to what degree it operates as a differentiating factor must necessarily be conjectural until experimental data has been secured.

In connection with the difference in the blood temperature the great difference in the metabolic processes of the hosts might also be considered, for the metabolic processes like the blood temperatures represent extremes and a mean. It is possible that no one of these factors suggested is capable of independently producing differentiations but that all of these together with other unknown factors migh cooperate in bringing about slight morphological changes from a common ancestral form. Stiles and Hassal (1896: 154) call attention to another factor that may account for many slight variations in mounted specimens of the same species, namely, the various methods of fixing, staining and mounting specimens and also the state of preservation of specimens when fixed. These factors should undoubtedly be taken into consideration in every comparative investigation and especially in the specific determination of a new form.

DESCRIPTION OF A NEW GENUS, AMPHIMERUS

When studied comparatively, the different species which constitute the genus *Opisthorchis* immediately arrange themselves in two well defined and easily distinguished groups. There are two very noticeable differences; in one group the vitellaria rarely extend caudad posterior to the ovary and consist of but one region on each side which is anterior to the ovary; in the other group the vitellaria extend caudad to and often posterior to the posterior

testis and consist of two regions, a postovarial and an antovarial region, which are well defined and separated by a break which occurs in the line of acini opposite or near the ovary. These differences are well marked and constant and no gradient or intermediate conditions occur. Thus in *O. interruptus* Brn., *O. lancea* Dies., *O. noverca* Brn., *O. pseudofelineus* Ward, *O. speciosus* St. and H. and *O. ovalis* n. sp., the vitellaria on each side are divided into two distinct regions by a break in the line of acini opposite the ovary and the vitellaria extend caudad to or posterior to the posterior testis, while in *O. felineus* Riv., *O. tenuicollis* R., *O. viverrini* P., *O. longissimus* von Lin., *O. simulans* Lss., *O. geminus* Lss., and *O. pisciola* Odhn., the vitellaria consist of but one region on each side and rarely extend caudad to the ovary.

Looss (1899: 675) considers the vitellaria to be one of the most constant and therefore one of the most reliable diagnostic characters not only in the genus *Opisthorchis* but in all the trematodes. In view of these well defined and constant differences in this most important character among the species which constitute the genus *Opisthorchis,* the division of the present genus into two distinct genera seems justifiable. The new species *O. ovalis* would serve as a good type species of this new genus and the diagnostic characters would be as follows:

Amphimerus nov. gen.

Body flattened, elongated, posterior portion broader than anterior which is tapering; *skin frequently covered wholly or in part by small retrose spinelets;* suckers not widely separated, the oral sucker larger than the acetabulum; digestive tract with distinct pharynx, slender œsophagus and two long simple intestinal cœca present; excretory system Y shape with sigmoid stem winding between the testes; genital pore median, immediately anterior to the acetabulum, copulatory organs absent; testes in posterior portion of body, simple or lobate, the one obliquely posterior to the other; ovary anterior to testes, simple or lobate; Laurer's canal prominent; receptaculum seminis well developed; uterine coils lie anterior to ovary and generally do not extend over the intestinal cœca; *vitellaria well developed and divided into two distinct regions by a break in the line of acini near the ovary; the antovarial region of the vitellaria does not extend cephalad beyond the acetabulum; the postovarial portion extends caudad to or beyond the posterior testis.*

Habitat. — Parasitic in the gall-ducts of Mammals, Birds and Reptiles.

Type species. — *Amphimerus ovalis* Barker, 1911.

In deciding on a name for this new genus the diagnostic character of the genus was borne in mind. The division of the vitellaria into two distinct regions or parts being the differentiating character of the genus the term *Amphimerus*, from the greek words ἀμφί meaning two and μέρος meaning part was decided on as being both descriptive and diagnostic and therefor appropriate for this new genus.

The generic name *Opisthorchis* may well be retained for those species of the old genus in which the vitellaria consist of a single region anterior to the ovary such as *O. felineus* Riv., *O. caninus* Barker, *O. geminus* Lss., *O. tenuicollis* R., *O. longissumus* von Lin., *O. simulans* Lss., *O. viverrini* P., *O. piscicola* Odhn, and *O. Entzi* von Ratz.

The new genus *Amphimerus* would contain the following species: *O. ovalis* Barker, *O. interruptus* Brn, *O. lancea* Dies, *O. noverca* Brn., *O. pseudofelineus* Ward and *O. speciosus* St. and H.

SYNOPSES OF THE SPECIES CONSTITUTING THE GENUS AMPHIMERUS.

Genus *Amphimerus* Barker, 1911

1895. *Opisthorchis* R. Blanchard, partim. Animaux parasites, in *Bull. Soc. Zool. France*, XX, p. 217.

1911. *Amphimerus* Barker, The present paper.

Generic diagnosis. — Fasciolidae: Body flattened, elongated, anterior end tapering. *Skin frequently covered wholly or in part by small retrose spinelets. Excretory* system Y shape with sigmoid stem winding between testes. *Copulatory organs* absent. *Testes* in posterior portion of body, simple or lobate; the one obliquely posterior to the other. *Ovary* anterior to testes, simple or lobate. *Laurer's canal* present; receptaculum seminis well developed; uterine coils anterior to ovary and *may extend laterally over the intestinal cæca; vitellaria well developed, lateral of intestinal cæca and divided into two distinct regions by a break opposite the ovary*; not extending anteriorly beyond the acetabulum but *frequently extending posteriorly to or beyond the posterior testis.*

Habitat. — Parasitic in the gall dutcs of Mammals, Birds and Reptiles.

Type species. — *Amphimerus ovalis* Barker, 1911.

Amphimerus ovalis Barker, 1911 (pl. XVII, fig. 5-9).

Specific diagnosis. — *Body* slender and oblanceolate; neck and body regions distinct; anterior two-thirds of body covered by small needle-like spinelets. Length of body 6 to 14.32 mm. by 0.45 to 1.373 mm across

body in region of ovary. *Oral sucker* sub-terminal 0.198 to 0.36 mm by 0.198 to 0.378 mm. *Acetabulum* in anterior fifth, sixth or seventh of body, 0.131 to 0.216 mm by 0.131 to 0.225 mm. *Genital pore* distinct at the anterior margin of the acetabulum in the median line. *Pharynx* 0.108 to 0.150 mm by 0.108 to 0.162 mm., *Oesophagus* 0.09 to 0.63 mm. *Intestinal cæca* unequal and extend to posterior end. *Testes* in posterior third of body, oval, ovate or orbicular, smooth or slightly lobed ; cirrus absent. *Ovary* oval, ovate or orbicular, smooth or slightly crenate. *Receptaculum* prominent, two to four times the size of the ovary. *Laurer's canal* prominent : *shell gland* diffuse and somewhat indistinct ; uterine coils of medium density and compactness. *Vitellaria* lateral of intestinal cæca, divided into two distinct regions by a break near the ovary. *Vitelline glands* begin 0.36 to 1.89 mm posterior to the acetabullum and extend to the posterior testis. *Eggs* short ovals, 0.024 to 0.312 mm by 0.014 to 0.019 mm with distinct lid but no opercular rim.

Habitat. — Bile ducts of Soft-shell Turtles (*Trionyx spinifer* Lesson and *Trionyx muticus* Lesueur).

Distribution. — Mississippi River in Minnesota and Iowa, U. S. A.

Amphimerus interruptus (Braun, 1901) Barker, 1911

(pl. XVIII, fig. 1)

1901. *Opisthorchis interruptus* Braun, Zur Revision der Trematoden der Vögel. II. *Centralblatt für Bakteriol.*, Abth. I, XXIX, p. 897.

1911. *Amphimerus interruptus* Barker, the present paper.

Specific diagnosis. — *Body* flattened, ligulate, tapering anteriorly ; posterior end pointed ; 7 to 8 mm long by 0.5 mm to 0.7 mm wide ; sides of body wavy. *Oral sucker* subterminal, 0.25 by 0.26 mm, acetabulum 0.135 mm in diameter and 1.3 mm. posterior to oral sucker. *Pharynx* 0.104 mm + 0125 mm. wide. *Œsophagus* about the length of pharynx. *Intestinal cæca* unequal, extending to posterior end. *Testes* unequal, lobed. *Cirrus* absent. *Ovary* oval, long diameter equal to testes. *Receptaculum seminis*, round or pear shape, smaller than testes. *Uterine coils* close. *Genital pore* close to acetabulum. *Vitellaria* divided into two regions, break opposite ovary constant and prominent, 0.6 mm long : *Vitelline glands* begin 1.3 mm. posterior to acetabulum and extend posteriorly to posterior testis. *Eggs* brown, 0.023 × 0.01 mm.

Habitat. — Intestine of *Ardea virescens* and *Alcedo viridirufa*.

Distribution. — Brazil.

Amphimerus lancea (Diesing, 1850) Barker, 1911

(pl. XVIII, fig. 4)

1850. *Distomum lancea* Diesing, *Systema helminthum*, I, p. 334.

1900. *Opisthorchis lancea* Weski, Mitteilungen über *Distomum lancea* Dies. *Ctrbl. Bakt.*, Abt. I, XXVII, p. 581.

1911. *Amphimerus lancea* Barker, the present paper.

Specific Diagnosis. — *Body* lanceolate, divided into neck and trunk regions; anterior end conical, posterior tapering; length 5.5 mm to 12.5 mm greatest width 1 to 2.8 mm, margins of body notched. *Oral sucker* subterminal, 0.33 to 0.36 mm by 0.51 to 0.66 mm, acetabulum in anterior third of body, 0.51 to 1.2 mm in diameter; genital pore a little anterior to acetabulum in median line. *Œsophagus* short. *Testes* orbicular sometimes four to five lobed. Cirrus absent. *Ovary* biscuit shape. *Receptaculum seminis* generally spindle shape; shell gland indistinct. *Vitellaria* lateral of intestinal cœca divided into two distinct regions, break between fourth and fifth groups. *Vitelline glands* begin just back of acetabulum and extend to end of intestinal cœca. *Eggs* oval, 0.029 to 0.033 by 0.012 to 0.014 mm.

Habitat. — Male *Delphinus Tacuschi* (*Steno tucuxi Gray*), *Orcella brevirostrias*.

Distribution. — Barra do Rio Negro, Brazil.

Amphimerus noverca (Braun, 1903). Barker, 1911 (pl. XX, fig. 1-3).

1876. *Distoma conjunctum* McConnell (nec Cobbold, 1859). On the *Distoma conjuctum* as a Human Entozoon. *The Lancet.*, 1876, p. 343-344, fig. 1-3.

1903. *Opisthorchis noverca* Braun, *Die thierischen Parasiten des Menschen.*, 3. ed., p. 164, fig. 112.

1911. *Amphimerus noverca* Barker, the present paper.

Specific diagnosis. — *Body* lanceolate; attenuate anteriorly; covered with spines; 9.52 to 12.7 mm long by 2.54 mm wide. *Oral sucker* terminal, larger than the acetabulum, distance between the two equal to about one-ninth the length of the body. *Genital pore* at anterior margin of acetabulum in the median line. *Pharynx* large and globular. *Oesophagus* very short or absent, intestinal cœca extend nearly to posterior end. *Testes* in posterior third of body, rounding or slightly lobate. *Cirrus* absent. *Ovary* slightly lobed, receptaculum seminis ? *Laurer's canal* ? uterine coils loose; shell gland ? *Vitellaria* lateral, beginning at level of acetabulum extend to the middle of posterior testis; vitellaria divided into two indistinct regions, break indistinct. *Eggs* oval, 0.0338 × 0.019 mm.

Habitat. — Bile ducts and gall bladder of Man.

Distribution. — India.

Amphimerus pseudofelineus (Ward, 1901). Barker, 1911 (pl. XVII, fig. 1-5).

1895. *Distomum felineum* Riv. Ward. On *Distomum felineum* in the United States and on the Value of Measurements in Specific Determinations among Distomes. *Veterin. Mag.*, II, p. 152-158.

1901. *Opisthorchis pseudofelineus* Ward, Notes on the Parasites of the Lake Fish. III : *Trans. Am. Mic. Soc.*, XXII, p. 180.

1911. *Amphimerus pseudofelineus* Barker, the present paper.

Specific Diagnosis. — *Body* oblanceolate, tapering anteriorly ; length 5 to 22 mm., breadth 1 to 3 mm in region of ovary ; minute needle-like spinelets on anterior portion of body. *Oral sucker* terminal or subterminal, 0.24 to 0.541 mm by 0.19 to 0.45 mm. *Pharynx* 0.12 to 0.26 by 0.14 to 0.28 mm. *Œsophagus* 0.04 to 0.38 mm long. *Intestinal cæca* unequal extending to posterior end. *Acetabulum* in anterior fourth or seventh of body, 0.14 to 0.31 mm by 0.17 to 0.32 mm. *Genital pore* at anterior margin of acetabulum. *Testes* in posterior fourth or fifth of body, orbicular, oval or elliptical, margin smooth, undulating or lobed. *Cirrus* absent. *Ovary* orbicular, oval or elliptical, margin smooth, undulating or lobed. *Receptaculum seminis* pear, oval or bag-shaped, larger than ovary. *Shell gland* anterior to ovary, diffuse and distinct. *Laurer's canal* prominent. *Uterine coils* dense and crowded. *Vitellaria* lateral, divided into two distinct regions, break opposite ovary distinct ; extend anteriorly to within 0.3 to 4.5 mm of acetabulum and posteriorly to posterior testis. *Eggs* 0.0313 by 0.0156 mm with distinct lid and opercular rim.

Habitat. — Biliary ducts of Cat (*Felis catus domestica*) and Coyote (*Canis latrans* Say).

Distribution. — Nebraska and Iowa, U. S. A.

Amphimerus speciosus (Stiles and Hassall, 1894) Barker, 1911 (pl. XVIII, fig. 2, 5, 6)

1894. *Distoma* (*Dicrocœlium*) *longissimum* var. *corvinum* Stiles and Hassall, Notes on Parasites, N° 21 : *Veterin. Mag.*, I, p. 418.

1896. *Opisthorchis speciosus* St. et H., Notes on Parasites, n° 42 : *Veterin. Mag.*, III, p. 155.

1899. *Opisthorchis longissimus* var. *corvinus* Looss, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 564.

1911. *Amphimerus speciosus* Barker, the present paper.

Specific diagnosis. — *Body* narrow and elongated, anterior end tapering ; anterior portion of body covered with retrose spinelets ; length 7.6 to 29 mm by 0.666 to 1.332 mm wide in region of ovary. *Oral sucker* subterminal, 0.291 to 0.366 mm by 0.291 to 0.357 mm. *Acetabulum* in the anterior third or fourth of the body, 0.178 to 0.244 mm by 0.178 to 0.244 mm. *Pharynx* 0.15 to 0.206 mm by 0.131 to 0.188 mm. *Œsophagus* 0.15 to 0.30 mm long. *Intestinal cæca* equal or unequal, extend to posterior end. *Testes* in posterior eighth of body, orbicular or oval, smooth or four lobed. *Cirrus* absent, genital pore not prominent, at the anterior

TABLE III. — COMPARATIVE TABLE OF THE SPECIFIC CHARACTERS

SPECIES	A. INTERRUPTUS	A. LANCEA
Investigator	Braun, Max	Weski, O.
Reference	1901 : 897	1900 : 579
Shape, body	ligulate	lanceolate
Length body	7-8 mm	5 5-12 5 mm
Breadth, body	0 5-0.7 mm	1-2 8 mm
Shape, ant. end	tapering	conical
Shape, post end	pointded	tapering
Spines	absent (?)	absent (?)
Oral sucker, position	subterm	subterm
Oral sucker, width	0 26 mm	0 51 0.66 mm
Oral sucker, length	0.25 mm	0.33-0.36 mm
Pharynx, length	0 104 mm	?
Pharynx, width	0.125 mm	?
OEsophagus, length	about 0 104 mm	short
Acetabulum, position	bet. 1" and 2" fifths	post. pt. ant. 3 d
Acetabulum, length	?	?
Acetabulum, width	0 135 mm	0.51-1.2 mm
Ovary, shape	elliptical	biscuit
Ovary, margin	smooth	indented
Receptaculum, shape	orbicular-pear	spindle, variable
Receptaculum, position	post. lat of ov	post. R of ov
Shell gland	?	indistinct
Testis, ant. shape	oval-orbic	orb.
Testis, ant. margin	4 lobed	smooth-4 lobe
Testis ant. position	post. 5". L	post. 4" L (?)
Testis, post. shape	orbic.	orb
Testis, post. margin	5 lobe	smooth-5 lobe
Testis, post. position	0 7-0.8 ant. to end	R (?)
Excretory system shape	?	Y
Excretory canal, shape	S	S
Cirrus and pouch	absent	absent
Vitellaria, extent ant.	1.3 mm post acet	diam. acet. post. to acet.
Vitellaria, extent post.	to post testis	end of int. cæca
Number of regions	2	2
Number of groups, acini	8 = 5 and 3 or 4 and 4	8 = 4 and 4
Break in line, acini	bet. 5 and 6 or 4 and 5	bet 4 and 5
Laurer's canal	?	?
Uterus	moderately dev.	mod. develop.
Eggs, shape	oval (?)	oval
Eggs, length	0 023 mm	0.029-0.33 mm
Eggs, width	0.010 mm	0.012-0.014 mm
Hosts	Water Birds	Dolphins
Distribution	Brazil	Brazil
Remarks	sides of body undulating	sides of body notched

A. NOVERCA	*A. OVALIS*	*A. PSEUDOFE-LINEUS*	*A. SPECIOSUS*
McConnell, Braun, Max	Barker, F. D.	Barker, F. D.	Barker, St. H.
1876 : 343 1903 : 170	1911 ; present paper	1911 : present paper	1911 : present paper 1894 : 418, 1896 : 151
lanceolate	slender, oblance.	oblanceolate	very elongate
9.5-12.7 mm	6-14 mm	5-22 mm	7.6-29 mm
2.5 mm	0.45-1.373 mm	1-3 mm	0.666-1 322 mm
attenuate	taper. conical	taper. conical	tapering
less"	taper. conical	broad, rounding	suddenly tap.
present	present, prom.	present, small	present, prom.
term	subterm.	term.-subter	subterm.
larger than	0.198-0 378 mm	0 24-0.54 mm	0.291-0.357 mm
acetabulum	0 198-0.360 mm	0 49-0.45 mm	0.291-0.366 mm
large	0.108-0.150 mm	0.12-0.26 mm	0.45-0.206 mm
globular	0.108-0.162 mm	0 14-0.28 mm	0.131-0.188 mm
absent (?)	0.09-0.63 mm	0.04-0.38 mm	0.15-0.30 mm
bet 1" and 2" ninths	ant. 5", 6" or 7"	ant. 4"-7"	ant. 3" or 4"
smaller than	0.131-0.216 mm	0.14-0.31 mm	0.178-0.244 mm
oral sucker	0.131-0.225 mm	0.17-0.32 mm	0.178-0 244 mm
tri-lobate	orbic.-oval	orb. oval, ellip.	oval. ovate, ellip.
slightly lobed	smooth-crenate	smooth-lobe	smooth-3 lobe
?	variable, large	var. pear, bag	oval-bag
?	R or L post. lat. ov.	R, L, post. lat. ov.	R, L, post. lat. ov.
?	indistinct	distinct	distinct
orbic. oval	orb.-oval	orb oval, ellip.	orb. oval
lobed	smooth	smooth-5 lobe	smooth-4 lobe
post. 3"	R or L	post R, L.	post. 8" R, L
orb. oval	orb. oval	orb. oval, ellip	orb. oval
lobate	smooth	smooth-5 lobe	smooth-4 lobe
post. 3"	R or L	post. R, L.	post. 8" R, L
Y	slightly Y	Y	slightly Y
slight S	slightly S	S	S
absent	absent	absent	absent
level of acet.	0.36-1.89 post. acet.	0.3-4.5 post. acet.	0.203 2.63 post. acet.
to post. testis	to post testis	to post. testis	post. to post testis
2, indistinct	2-3	2-3	2
?	8 = 5 and 3 or 4 and 4	8 = 5 and 3	7 — 8 = 5 and 3, 5 and 2
?	bet 5" and 6" or 4" and 5"	bet. 5" and 6"	bet. 5" and 6"
?	prominent	prominent	prominent
poorly develop.	mod. develop.	well develop.	very well develop.
oval	short oval	oval	long oval
0.034 mm	0.024-0.031 mm	0 0313 mm	0 026-0.033 mm
0.019 mm	0 014-0.019 mm	0.0156 mm	0.015-0.018 mm
Man	Soft-shell Turtle	Cat, Coyote	Crow, Egret
India	Minn., U.S.A	Nebr., Ia., U.S A.	Md, D.C., U.S.A.

margin of the acetabulum. *Ovary* in posterior fifth of body, oval, ovate or elliptical, smooth to three lobed. *Receptaculum seminis* smaller than or equal to the ovary ; *Shell gland* diffuse and distinct. *Laurer's canal* prominent ; uterine coils very dense and close, frequently extending laterally over the intestinal cœca. *Vitellaria* divided into two distinct regions by a distinct break near the ovary ; vitelline glands begin 0.203 to 2.63 mm posterior to the acetabulum and extend to the posterior testis. *Eggs* long ovals, with distinct lid and opercular rim, 0.026 to 0.033 mm by 0.015 to 0.018 mm.

Habitat. — Bile ducts of Crows (*Corvus americanus*, *Corvus ossifragus*), and Egrets.

Distribution. — Maryland and District of Columbia, U. S. A.

SYNOPSES OF THE SPECIES CONSTITUTING THE GENUS OPISTHORCHIS.

Genus *Opisthorchis* R. Blanchard, 1895

1895. *Opisthorchis* R. Blanchard, Animaux parasites, *Bull. Soc. Zool. de France*, XX, p. 217.

1895. *Opisthorchis* Blanchard, Maladies parasitaires, in *Traité de pathol. gén.* de Ch. Bouchard, II, p. 730.

1898. *Campula* p. p. Stiles and Hassall, Notes on parasites. N° 48. An inventory of the genera... of *Fasciolidae*. *Archives de Parasitologie*, I, p. 85.

1899. *Opisthorchis* Looss, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 564.

1911. *Opisthorchis* Barker, the present paper.

Generic diagnosis. — *Fasciolidae*: *Body* distinctly, often very greatly elongated, anterior end attenuated, posterior end broader. *Skin* generally smooth, without spines. *Excretory system* with long sigmoid stem winding between the testicles, and with short branches. *Copulatory organs* absent. *Testicles* in posterior portion of body, the one obliquely posterior to the other, margins lobed. *Ovary* simple or lobate. *Laurer's canal* present. *Receptaculum seminis* prominent. *Uterine coils* anterior to ovary, but not extending materially over the intestinal cæca. *Vitellaria* moderately developed, lateral of intestinal cæca, not extending anteriorly beyond the acetabulum and extending posteriorly to the ovary ; *vitellaria form one region*.

Habitat. — Parasitic in the gall ducts of Mammals, Birds and Fishes.

Type species. — *Opisthorchis felineus* (Rivolta, 1884).

Opisthorchis felineus (Rivolta, 1884) (pl. XVIII, fig. 3 et 7).

1831. *Distoma conus* Gurlt, *Lehrbuch der pathologischen Anatomie der Haus-Säugethiere*. I, p. 373-375.

1836. *Distoma lanceolatum* von Siebold, Helminth. Beiträge, II. *Archiv für Naturg.*, I, p. 113.

1884. *Distomum felineum* Rivolta, Sopra una specie di Distoma nel Gatto e nel Cane. *Giornale di. anat. fisiol., e. patol. degli animali,* XVI, p. 20.

1895. *Opisthorchis felineus* (R. Blanchard), Animaux parasites. *Bull. Soc. Zool. France*, XX, p. 217.

Specific diagnosis. — *Body* flat, lanceolate, anterior end conical forming a more or less well marked neck region anterior to the acetabulum, 8 to 13 mm long by 1.5 to 2 mm wide; body yellowish-red and almost transparent in the fresh condition. *Oral sucker* and acetabulum of about equal size, 0.23 to 0.25 mm., oral sucker terminal to subterminal, acetabulum in anterior fifth or sixth of body; skin without spines. *Genital pore* close in front of acetabulum. *Pharynx* small, 0.204 by 0.161 mm. *Oesophagus* 0.2 mm. long. *Intestinal cæca* extend to posterior end of body. *Testes* in posterior fourth of body, four to five lobed; cirrus and pouch absent. *Ovary* smooth or slightly lobate; uterus moderately well developed; shell gland diffuse. *Receptaculum seminis* well developed. *Laurer's canal* present. *Vitellaria* lateral of intestinal cæca, composed of seven to nine groups of acini comprising one region occupying the middle third of the body, beginning just back of the acetabulum and extending to the level of the ovary. *Eggs* oval with well defined lid, 0.026 to 0.030 mm. by 0.011 to 0.015 mm.

Habitat. — Gall ducts of domesticated Cat, Dog, Glutton, Fox and Man.

Distribution. — Europe (France, Holland, North Germany, Russia, Scandinavia, Siberia, Japan?, Hungary and Italy).

Opisthorchis caninus (L. and C., 1872) Barker, 1911 (pl. XX, fig. 5-7).

1872. *Distoma conjunctum* Lewis and Cunningham (nec Cobbold, 1859). Microscopical and Physiological Researches into the Nature of the Agent or Agents Producing Cholera. 8th *Ann. Report San. Com. Gov. India for 1871.* Calcutta, 1872, p. 168, fig. 1-4.

1903. *Opisthorchis novercа* Braun, *Die thierischen Parasiten des Menschen*, 3. ed., p. 164.

1911. *Opisthorchis caninus* Barker, the present paper.

Specific diagnosis. — *Body* slightly lanceolate; covered with spinelets; average length 6.36 mm, width of body across acetabulum 1.27 mm., width across ovary 2 mm. *Acetabulum* on acetabular papilla between first and second anterior fifths; smaller than oral sucker; genital pore at anterior margin of acetabulum. *Pharynx* cordate. *Oesophagus* short. *Intestinal cæca* about equal and extend almost to posterior end of body. *Testes*

in posterior third of body, lying close together the one obliquely behind the other, both orbicular with slightly undulating margins. *Ovary* at beginning of posterior half, lying transversely, elliptical with notched border. *Receptaculum seminis* and *Laurer's canal* not shown; cirrus absent. *Uterus* in median field, extends from ovary to acetabulum, uterine coils well developed. *Vitellaria* lateral to intestinal cæca, extend from level slightly posterior to acetabulum to middle of anterior testes; vitelline glands not divided into antovarial and postovarial regions, acini quite distinct, seven on each side. *Excretory canal* posterior and median, sigmoid, winding between the testes. Eggs oval, lids distinct, opercular rim absent, size 0.0216-0.025 by 0.0116-0.013 mm.

Habitat. — Gall ducts of Pariah Dogs.

Distribution. — India.

Opisthorchis Entzi von Rátz, 1900.

1900. *Opisthorchis Entzi* von Rátz, Parasitologiae jegyzetek. *Veterinarius*, Budapest, XXIII, p. 532-534.

von Rátz (1900 : 532) describes a Distome which he has found in the gall cyst of the Blue Heron (*Ardea purpurea*) in Hungary. His description in brief is as follows :

« *Body* flat, lanceolate in shape and transparent ; anterior portion whitish and posterior brownish yellow ; anterior end tapering and constricted at the level of acetabulum forming a neck region anterior to the acetabulum ; posterior portion of the body broader and the end rounding ; length 12 to 13.2 mm., breadth at the widest part 1 to 1.2 mm. *Oral sucker* 0,25 mm in diameter ; acetabulum 2.38 mm. posterior to the oral sucker and a little larger, measuring 0.31 mm in diameter. *Pharynx* oval or heart shape and followed by a short œsophagus and a forked intestinal tract, the cæca ending in blind enlargements in the posterior end of the body. *Cirrus* and cirrus sac absent. *Testes* lie in the posterior half of the body, the one behind the other, 4 to 5 lobed ; vas efferens from each testis unite to form the vas deferens which passes forward to the genital pore just anterior to the acetabulum. *Ovary* in the middle of the body and slightly lobed ; retort shaped receptabulum seminis and tubular Laurer's canal just posterior to the ovary. *Vitellaria* lateral to the intestinal cæca and extend from near the acetabulum to the ovary ;acini of the vitelline glands somewhat indefinite being crowded together in places ; vitelline glands extend farther cephalad on the right side than on the left ; two vitelline ducts, one from each side, lead posteriorly to the ovary where they unite. *Uterine coils* well developed and fill the body between the intestinal cæca and the ovary and acetabulum, but the coils do not extend over the intestinal cæca. *Shell gland* distinct and just anterior to the ovary. *Eggs* oval, more pointed at the anterior end where the operculum with an opercular rim are found ; they measure 0.0242 mm by 0.0132 to 0.0154 mm. »

TABLE II. — **COMPARATIVE TABLE OF THE SPECIFIC CHA**

SPECIES	*O. FELINEUS*	*O. GEMINUS*	*O. LONGIS-SIMUS*	*O. PISCICOL*
Investigator	Max Braun	Looss	von Linstow, St & H	Odhner, T.
Reference	1908 : 186. 1901 : 315	1896 : 50. 1899 : 676	1883 : 274. 1894 : 418	1902 : 152
Shape, body	flat, lanceolate	flat, tapering	very elongate	tapering
Length, body	8-13 mm	7-12 5 mm	20 mm	3-4 mm
Breadth, body	1 5-2 mm	1.3-2 mm	1 mm	0.5 mm
Shape, ant. end	conical	tapering	cylindrical	rounding
Shape, post. end	rounding-point	rounding	rounding	pointed
Spines	absent	absent	absent	present, small, bro
Oral sucker, position	term.-subterm.	subterminal	?	?
Oral sucker, width	0.263-0.280 mm	0.17	0 28 mm	0.19-0.22 mm
Oral sucker, length	0.228 mm	0.17	?	?
Pharynx, length	0.204-0.169 mm	?	nearly as large	?
Pharynx, width	0.161-0.170 mm	0 1 mm	as oral sucker	0 08 mm
Esophagus, length	0 20-0.21 mm	0.25 mm	as long as phar.	?
Acetabulum, position	ant. 5" or 6"	ant. 4" or 5"	ant. 6"	bet. 1"+ 2" fifths
Acetabulum, length	0.247-0 228 mm	less than	?	0.26 mm
Acetabulum, width	0 197-0.228 mm	oral sucker	0.34 mm	0 30 mm
Ovary, shape	orbicular	oval	follicular	?
Ovary, margin	smooth-lobe	smooth-3 lobe	very lobate	crenated
Receptaculum, shape	large, pear, retort	large, bag	large, globular	?
Receptac., position	R. L. post. lat. ov.	?	?	?
Shell gland	distinct	indistinct	distinct (?)	?
Testis, ant. shape	orbic.-oval	orb.-oval	orbic.-oval	?
Testis, ant. margin	4 lobe	4 lobed	2 lobe	slightly lobed
Testis, ant. position	post. 4" R. L.	post. 5" or 6"	post. 6"	in median line
Testis, post. shape	orbic.-oval	orb.-oval	orbic.-oval	?
Testis, post. margin	5 lobe	5 lobed	4 lobe	slightly lobed
Testis, post. position	post. 4" R, L.	post. 5" or 6"	post. 6"	in median line
Excretory syst. shape	Y	Y	?	?
Excret. canal, shape	S	S	S	?
Cirrus and pouch	absent	absent (?)	absent	absent (?)
Vitellaria, extent ant.	immed. post. acet.	ant. 3d-mid.	in 3" fourth	in middle 3"
Vitellaria, ext. post.	to ovary	to ovary	to ovary	to ovary
Number of regions	1	1	1	1
Number of groups, acini	7-9	7-8	?	?
Break in line, acini	absent	absent	absent	absent
Laurer's canal	present	present	?	?
Uterus	mod. develop.	moderate	well develop.	?
Eggs, shape	oval	oval	oval	oval (?)
Eggs, length	0.026-0 030 mm	0 021-0 027 mm	0 026 mm	0.021 mm
Eggs, width	0 011-0 015 mm	0 01-0 013 mm	0.015 mm	0 011 mm
Hosts	Cat, Dog, Fox, Man	Water Birds	Water Birds	Nile Fish
Distribution	Europe	Egypt	Turkestan	Omdurman
Remarks				Description from few specimens

CTERS OF THE SPECIES IN THE GENUS OPISTHORCHIS

O. SIMULANS	*O. TENUICOLLIS*	*O. VIVERRINI*	*O. ENTZI.*	*O. CANINUS*
Looss	Rudolphi, Braun	Poirier	von Rátz	Lewis & Cunningham, Barker
1896 : 52	1819 : 93 et 365	1886 : 27	1900 : 532	1872 : 168. 1914
1899 : 673	1901 : 315			
slightly taper	lanceolate	lanceolate	lanceolate	slightly lanceolate
7-23 mm	6.5-7-10.12 mm	6 mm	12-13 2 mm	6 36 mm
1-1 5 mm	1.12 mm	2 mm	1-1.2 mm	1.27 2 mm
rounding	thin	tapering	tapering	conical
tapering	bluntly pointed	round. pointed	rounding	pointed
absent	?	absent (?)	absent (?)	present
subterm.	?	?	terminal	subterminal
0.5 mm	0.134 mm	0.23 mm	0 25 mm	larger than acetab.
0.5 mm	0 152 mm	?	—	larger than acetab.
?	0 093 mm	?	—	cordate
0 3 mm	0 039 mm	?	—	cordate
short (?)	?	3 times large phar.	—	short
ant. 3rd	bet. 1st 2nd fourths	bet. 1st 2nd third	bet. 1st 2nd fifths	bet. 1st & 2nd fifths
0 2 mm	0 219 mm	?	—	smaller than oral
0 02 mm	0 219 mm	0 23 mm	0 31 mm	smaller than oral
follicular	oval	?	—	elliptical
very lobate	smooth (?)	multi-lobed	slight. lobed	notched
small. oval	bag like (?)	oval-bag (?)	retort	?
—	?	post. lat. ov.	post. lat ov.	?
indistinct	?	diffuse	distinct	?
orbic.-ellip.	orbic.-oval (?)	orbic. (?)	4-5 lobed	orbicular
smth.-undul.	4-5 lobe	4 lobed	—	undulating
—	post. 4th	in post. 5th (?)	post. 1/2	post. 3rd
orbic.-ellip	orbic.-oval (?)	orbic. (?)	4-5 lobed	orbicular
smth.-ellip.	4-5 lobe	4 lobed	—	undulating
post. 4th	post 4th	in post. 5th (?)	post. 1/2	post. 3rd
Y	?	?	Y	?
S	S	S	" S " ?	S
absent	absent (?)	absent (?)	absent	absent
middle of body	about acet.	just post. to acet.	near acet.	just post. to acet.
to ovary- ant test.	to ovary	just post. to ov.	near ovary	mid. ant testis.
1	1	1	1	1
8	7-8 (?)	?	?	7
absent	absent	absent	absent	absent
short. present.	?	present	present	?
moderate	profuse	poorly develop.	moderate	well develop.
oval	elliptical	ovoid	oval	oval
0 028-0 029 mm	0.0228 mm	0 026 mm	0.0242 mm	0.0216-0 025 mm
0 016-0 018 mm	0.009-0 014 mm	0 013 mm	0.0132-0 0154 mm	0.0116-0.013 mm
Water Birds	Seals. Cat ? Dog ? Man ?	Civet Cat	Blue Heron	Pariah Dogs
* Egypt	Europe	France	Hungary	India

Habitat. — Parasitic in the gall cyst of *Ardea purpurea* L.
Distribution. — Hungary.

Opisthorchis geminus (Looss, 1896) (pl. XIX, fig. 4).

1896. *Distomum geminum* Looss, Recherches sur la faune parasitaire de l'Egypte. Première partie. *Mém. de l'Inst. égypt.*, III, p. 50.

1899. *Opisthorchis geminus* Looss, Weitere Beiträge zur Kenntniss der Tremoden-Fauna Aegyptens. *Zool. Jahrbücher, Syst.*, XII, p. 675.

Specific diagnosis. — *Body* flat, elongated, tapering toward the anterior end and increasing in size toward the posterior; posterior end rounding; spines and spinelets absent, skin very delicate; length 7 to 12.5 mm by 1.3 to 2 mm wide at widest part. *Oral sucker* subterminal 0.17 mm in diameter; acetabulum slightly smaller than oral sucker and situated at the beginning of the second anterior fourth of body. *Pharynx* 0.1 mm in diameter, *Œsophagus* 0.25 mm long. *Intestinal cæca* extend to posterior end. *Excretory system* Y shape, canal sigmoid winding between testes. *Testes* in posterior fifth or sixth of body, the anterior four lobed, the posterior five lobed, greatest diameter 0.6 mm. *Cirrus* absent, small genital sinus present, immediately anterior to the acetabulum. *Ovary*, three lobed, slightly smaller than the testes. *Shell gland* indistinct. *Laurer's canal* prominent. *Receptaculum seminis* larger than ovary ; uterine coils of medium development. *Vitellaria* consist of one region, lateral to the intestinal cæca; vitelline glands begin about the anterior third or middle of the length of the body and extend to the ovary. *Eggs* oval in shape with lid (opercular rim absent) 0.02 mm. to 0.027 long by 0.01 to 0.013 mm. wide.

Habitat. — In the liver of *Milvus parasiticus*, *Anas boschas fera*, *Circus æruginosus*.

Distribution. — Egypt.

Opisthorchis longissimus (von Linstow, 1883) (pl. XIX, fig. 2).

1883. *Distomum longissimum* von Linstow, Nematoden, Trematoden und Acanthocephalen etc. *Arch. Naturg.*, Jahrg. 49, 1, p. 308.

1894. *Distoma* (*Dicrocœlium*) *longissimum* St. et H., Notes on Parasites, nº 21 *Veterin. Mag.*, I, p. 418.

1896. *Opisthorchis longissimus* (St. et H.), Notes on Parasites, nº 42. *Veterin. Mag.*, III, p. 155.

1899. *Opisthorchis longissimus* (Looss), Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb.*, *Syst.*, XII, p. 364.

Specific diagnosis. — *Body* very elongate, cylindrical, 20 mm long by 1 mm broad; spines absent. *Oral sucker* 0.28 mm in diameter. *Acetabulum* slightly larger (0.34 mm) on boundary of first and second anterior sixths of body. *Genital pore* immediately anterior to acetabulum. *Pharynx* nearly as large as oral sucker. *Œsophagus* as long as pharynx. *Intestinal cæca* extend to posterior end of body. *Testicles* lobate, in posterior sixth, one in front of the other; cirrus absent. *Ovary* lobate (follicular). *Receptaculum seminis* large, globular; shell gland anterior to ovary, diffuse. *Vitellaria* consist of one region, lateral, in third fourth of body; not extending posterior to ovary. *Eggs* 0.026 mm by 0.015 mm.

Habitat. — Biliary ducts of *Ardea stellaris.*

Distribution. — Turkestan.

Opisthorchis piscicola Odhner, 1902.

1902. *Opisthorchis piscicola* Odhner, Mitteilungen zur Kenntnis der Distomen. II. *Centralblatt für Bakt.*, Abt. I, XXXI, p. 152.

Specific diagnosis. — *Body* 3 to 4 mm long, greatest width, 0.5 mm at middle of body; body tapers markedly toward anterior and slightly toward posterior end; anterior end rounding; posterior end pointed. *Oral sucker* round, 0.19 to 0.22 mm in diameter. *Acetabulum* oval, 0.26 × 0.3 mm situated between the first and second fifths of the body. *Skin* covered with small, broad spines. *Pharynx* 0.08 mm in diameter. *Testicles* slightly lobed, lying in the median line. *Ovary* more or less crenated. *Genitals* immediately posterior to one another. *Vitellaria* extend from posterior margin of ovary, anteriorly to the middle third of body. *Eggs* 0.021 mm. long and 0.011 mm. wide.

Habitat. — Gall bladder of Nile Fish (*Gymnarchus niloticus*).

Distribution. — White Nile, Omdurman.

Opisthorchis simulans (Looss, 1896), (pl. XIX, fig. 1 et 3).

1896. *Distomum simulans* Looss, Recherches sur la faune parasitaire de l'Egypte. Première partie. *Mém. de l'Inst. égypt.*, III, p. 52.

1898. *Opisthorchis simulans* (Looss), *var. poturzycensis* M. Kowalewski, Etudes helminthologiques, V. *Bull. intern. Acad. sc. Cracovie,* p. 71-73.

1899. *Opisthorchis simulans* (Looss), Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 673.

Specific diagnosis. — *Body* flat, elongated, anterior portion only slightly tapering, posterior end slightly tapering; length 7 to 23 mm by 1 to 1.5 mm across the middle of the body. *Oral sucker* subterminal, 0.5 mm in diameter, acetabulum in the anterior third of body 0.2 mm in diameter, spines and spinelets absent. *Pharynx* well developed 0.3 mm.

in diameter. *Œsophagus* short or absent, intestinal cæca extend to the posterior end of the body. *Excretory system* Y shape, canal sigmoid. *Testes* in anterior fourth or fifth of body, spherical or elongated (margins undulating), 0.6 mm in greatest diameter. *Cirrus* absent. *Genital orifice* and sinus anterior to acetabulum. *Ovary* very lobate (follicular). *Receptaculum seminis* small. *Laurer's canal* short. *Shell gland* indistinct. *Uterine coils* of medium development. *Vitellaria* consist of one region lateral to intestinal cæca ; vitelline glands begin about the middle of the length of the body and extend to the ovary or to the anterior testis. *Eggs* 0.028 to 0.029 mm by 0.016 to 0.018 mm.

Habitat. — In the liver of *Anas penelope*, *Fulix cristata*, *Circus æruginosus* and *Pernis apivorus*.

Distribution. — Nile, Egypt.

Opisthorchis tenuicollis (Rud., 1819), (pl. XX, fig. 4).

1819. *Distoma tenuicollis* Rudolphi, *Entozoorum Synopsis*. p. 93 et 365.

1896. *Opisthorchis tenuicollis* (Stiles and Hassall). Notes on Parasites, N°. 42. *Veterin. Mag.*, III, p. 155.

1899. *Opisthorchis tenuicollis* (Looss), Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegypt. *Zool. Jahrb., Syst.*, XII, p. 564.

Specific diagnosis. — *Body* lanceolate, flat, anterior end markedly tapering and thin, posterior end bluntly pointed ; body 6.5 to 10.12 mm by 1.12 mm. *Oral sucker* 0.134 by 0.152 mm. *Acetabulum* 0.219 mm in diameter, situated between first and second fourths of the body. *Skin* without spines. *Ovary* oval, smooth. *Receptaculum seminis* well developed. *Laurer's canal* ? *shell gland* ? *Testes* in posterior fourth of body four to five lobed. *Vitellaria* in one region lateral to the intestinal cæca. *Vitelline glands* begin just posterior to the acetabulum and extend to the ovary. *Uterus* profusely developed. *Eggs* elliptical, 0.0228 by 0.009 to 0.014 mm.

Habitat. — Reported for domestic Cat ? Dog ? and Man ? *Gulo borealis*, *Phoca barbata*, *Halichœrus grypus*, *Erignathus barbatus*, *Delphinus phocæna*, *Phocæna phocæna*.

Distribution. — Europe.

Opisthorchis viverrini (Poirier, 1886) (pl. XX, fig. 8-10).

1886. *Distomum viverrini* Poirier, Trématodes nouveaux ou peu connus. *Bull. Soc. philomat.*, Paris (7), X, p. 27-29.

1894. *Dicrocoelium viverrini* (Stiles and Hassall), Notes on Parasites, N° 21, *Veterin. Mag.*, I, p. 427.

1896. *Opisthorchis viverrini* (Stiles and Hassall), Notes on Parasites, N° 42 *Veterin. Mag.*, III, p. 155.

Specific diagnosis. — *Body* lanceolate, 6 mm long by 2 mm broad.

Oral sucker 0.23 mm in diameter. *Acetabulum* at boundary between first and second anterior thirds of body, same size as oral sucker. *Pharynx* present. *Œsophagus* three times as long as pharynx, intestinal cæca extend to posterior extremity. *Genital pore* immediately anterior to acetabulum. *Testes* four lobed in posterior end, one anterior to the other. *Ovary* multi lobed. *Receptaculum seminis* lateral of ovary. *Laurer's canal* present. *Shell gland* rather diffuse. *Vitellaria* lateral of intestinal cæca, beginning just behind the acetabulum and extending slightly beyond the ovary. *Uterus* in second third of body ; coils loose. *Eggs* ovoid 0.026 by 0.013 mm.

Habitat. — Bile duct of *Felis viverrinus*.

Distribution. — France.

COMPARATIVE STUDY OF THE EUROPEAN SPECIES.

The comparative study of the tabulated specific characters of the species constituting the genus *Opisthorchis* (see table II, p. 544) shows one or more well defined specific characters for each in the case of the majority of the species, however in the case of several, the specific characters are strikingly alike and are therefore not so differentiating in their character.

An examination of the table referred to above shows the following characters to differentiate *O. piscicola* from the other members of the genus : its minute size, the relatively large size of the suckers, the presence of small, broad spines, which are absent in all of the other species, the relatively large size of the eggs and its piscine host. It is to be regretted that the number of specimens was so few on which the specific diagnosis was based and that no figure of this new species accompagnies Odhner's description.

O. viverrini differs from the other species in respect to the poorly developed condition of the uterine coils and perhaps also the more nearly equal size of the suckers and the anterior position of the anterior limit of the vitelline glands. There are certain strikingly similar characters in *O. viverrini*, *O. tenuicollis*, *O. felineus* and *O. geminus* which will be discussed later.

In the case of *O. tenuicollis* one does not find any marked specific character which separates it from all of the other species, the characters differ in the degree of variation rather than in kind, the specific characters of *O. tenuicollis*, *O. felineus* and *O. geminus* rae therefore strikingly similar.

The oral sucker of *O. tenuicollis* seems to be constantly smaller than the acetabulum, at least the area of the oral sucker is less than that of the acetabulum ; this constant difference in the size of the two suckers may be considered of specific value and differentiates *O. tenuicollis* from *O. felineus* and *O. geminus* in which the area of the oral sucker is constantly greater than that of te acetabulum.

The diameters of the suckers may vary greatly in different specimens of the same species as in the case of *A. pseudofelineus* and *A. oralis* in which there is often a variation of 0.25 mm or more (tab. I, p 525) but the relative size of the suckers varies little and because of this constancy may well be considered of specific value as a differentiating character.

Mühling (1896 : 257) makes *O. felineus* identical with *O. tenuicollis* and also identifies certain distomes found in *Halichoerus grypus* as *O. tenuicollis.*

Braun (1901 : 314) questions the indentity of *O. tenuicollis* and *O. felineus* and the new distomes found by Mühling, basing his objections on the difference in size of the bodies, and the various organs, suckers, testes, pharynx and eggs ; also the difference in the shape of the bodies of the above mentioned species and the difference in their hosts. From the data obtained in the study of the variations of these organs in *A. pseudofelineus* and *A. oralis* (tab. I, p. 525) it seems that the small size of the body and organs of Mühling's distome would not preclude it from either *O. tenuicollis* or *O. felineus*, but the nearly equal size of the suckers, the small size of the body and the other organs favor its identity with *O. tenuicollis.*

The characters of *O. Entzi* are almost identical with the characters of *O. tenuicollis* and very similar to those of *O. felineus* and *O. geminus* with the exception of the relative sizes of the suckers. In both *O. felineus* and *O. geminus* the oral sucker is larger than the acetabulum while in *O. Entzi* the acetabulum is the larger. We are inclined to give this difference a specific value for the comparative study of the variations in the sizes of the oral sucker and acetabulum of *A. pseudofelineus* and *A. oralis* has shown the relative sizes of these organs to be quite constant for each species. With respect to the size and shape of the organs and the eggs, *O. Entzi*

is most like *O. tenuicollis* but the same objection which Looss (1899 : 676) raises in regard to making *O. geminus* identical with *O. tenuicollis* (R.), namely the avian hosts of *O. geminus* and *O. Entzi*, must prevent us from making *O. Entzi* identical with *O. tenuicollis*. With respect to the host, *O. Entzi* might more easily be considered identical with *O. geminus*, for both are found in the liver of an avian host.

The specific rank of such nearly identical forms is very difficult to determine with the present meagre comparative data and the absence of data on the life history and feeding experiments. It is to be regretted that no figure accompagnies von Rátz' description of *O. Entzi*.

O. simulans and *O. longissimus* (pl. XIX, fig. 1-2) have one striking character in common, namely the multi-lobed condition of the ovary in each case. The figures given both by von Linstow (1883) and Stiles and Hassall (1896 : 153) of *O. longissimus* plainly show this character as does also the specific diagnosis of von Linstow (1883). Looss (1896 : 52) describes the ovary of *O. simulans* as « assez petit et à contour plusieurs fois échancré », but the detailled drawing (plat. XIX, fig. 3) given by him does not show this striking character; again in a later description Loos (1899 : 673) describes the ovary as « der Keimstock viellappig » and his drawing (pl. XIX, fig. 1) clearly shows this character.

O. simulans also differs from *O. longissimus* with respect to the relative size of the suckers ; the oral sucker is constantly twice as large as the acetabulum in *O. simulans*, while in *O. longissimus* the condition is the opposite, the acetabulum being larger than the oral sucker. The uterine coils are more strongly developed in *O. longissimus*, the testes are larger and are distinctly two or four lobed, their long diameter is transverse and they occupy a more posterior position in the body ; the posterior end also is much more rounding in *O. longissimus* than in *O. simulans*. Unless the difference in the shape of the posterior ends of the bodies and the positions of the long axes and the lobing of the testes is constant in all the specimens of these two species, these differences might be due to the varying degrees of contraction of these parts ; such differences we have observed in the posterior end and in the testes of a living and actively contracting specimen of *A. pseudofelineus*,

in which the position of the long axis of the testis changed rapidly from transverse to longitudinal, the shapes of the testes changed from orbicular to oval and elliptical and the margins became undulating and even markedly two to five lobed, the posterior end also changed from a rounding form to a decidedly pointed form.

Looss (1899 : 674) calls attention to the noteworthy fact that we have in *O. simulans* the occurrence of the same species of distome, with slight variations, in two distinctly different groups of birds. Looss also mentions the many characters common to both *O. simulans* and *O. longissimus* and concludes by saying « so würde ich doch nicht überrascht sein, wenn sich später die Identität auch dieser beiden Formen noch herausstellen sollte ».

Looss does not recognise Kowalewski's new variety *O. simulans* var. *poturzycensis* from the liver of *Anas boschas dom.* as he considers it does not differ essentially from *O. simulans*.

In comparing the characters of *O. geminus* and *O. felineus* one is immediately impressed with the very close ressemblance of these two species in every character and must concur with Looss (1899 : 676) who emphasizes the specificity of the host of *O. simulans*, this species having been found only in avian hosts tho cats, dogs, foxes, wolves and wildcats were carefully examined, and concludes by saying « Diese Ueberlegung ist der einzige Grund, der mich noch abhält, den von mir beschriebenen *O. geminus* direct für identisch zu erklären mit *O. tenuicollis* (R.) » (= *D. felineum* Riv.)

Galli-Valerio (1898 : 145) describes and gives a drawing of a Distome which he found in *Anas boschas* L. as a new species belonging to the genus *Opisthorchis*.

Kowalewski (1898 : 751) questions the validity of the identification of this new species and suggests that certain characters have been overlooked which would preclude this new species from the genus *Opisthorchis* and would place it in the genus *Echinostomum* and make it identical with *E. conoideum* (Bloch, 1872) M. Kow., 1896.

Galli-Valerio (1898 : 923) tho admitting that the form which he found may not belong to the genus *Opisthorchis*, maintains that it is not identical with *E. conoideum* and is therefore a new species.

Inasmuch as Kowalewski has made a careful study both of *E. conoideum* and also the genus *Opisthorchis* we shall accept his opinion as to the validity of Galli-Valerio's *O. Pianae* and not include it in the genus *Opisthorchis*.

One must also agree with Looss (1899 : 677) that the *Opisthorchiinae* offer very real difficulties to the systematist and that the specific rank of certain species cannot be absolutely determined until feeding experiments have been carried on to determine whether these forms are distinct species specific to each host or whether they are only varieties of the same species modified by their parasitism in different hosts.

I expect to carry on certain feeding experiments next summer with the new species found in the Soft-shell Turtle, with the hope that some light may be shed on this obscure but very important question. If one may offer an opinion as to the specific nature of the species constituting the genera *Amphimerus* and *Opisthorchis* without having examined and compared the original specimens on which the descriptions have been based, I am of the opinion that feeding experiments and comparative study in much greater detail of a much larger number of specimens of each species would demonstrate the identity of several of the very similar species or would reveal more definite and decided specific differences among them.

I am also convinced that there is need for more careful drawings and more detailed descriptions based on the comparative study of a larger number of specimens in the case of new species in order to avoid uncertainty and confusion in the future.

KEY TO THE GENERA OF THE SUBFAMILY OPISTHORCHIINAE LOOSS, 1899

1899. *Opisthorchiinae* Looss, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 563.

Diagnosis. — *Fasciolidae* of *medium size, with slender elongated body, noticeably tapering anteriorly. Suckers* are near each other and generally not strongly developed. *Pharynx* present. *Œsophagus* short and slender, intestinal cæca long and simple. *Excretory system* is Y shape, arms short, main stem long and S shape winding between the testes. *Genital pore* is median and anterior to the acetabulum. *Copulatory organs* absent. *Testes* close together in the posterior end, the one more or less obliquely behind

the other. *Laurer's canal* is present. *Receptaculum seminis very strongly developed*; *Uterine coils* anterior to the ovary. *Vitellaria* strongly developed, lateral of the intestinal cæca.

Found in the bile ducts or gall bladder of Man, Mammals, Birds, Reptiles and Fish.

1. Vitellaria lateral to intestinal cæca 2
   Vitellaria anterior to intestinal cæca, lateral to œsophagus ; uterine coils fill entire body posterior to acetabulum . . . *Holometra*.
2. Vitellaria not extending anteriorly beyond the acetabulum . . 3
   Vitellaria extending beyond the acetabulum . . . *Metorchis*.
3. Vitellaria not divided into two distinct regions by a break in the line of acini near the ovary 4
   Vitellaria divided into two regions . . . . . *Amphimerus*.
4. Testes dendritic 5
   Testes not dendritic . . . . . *Opisthorchis*.
5. Testes dendritic . . . . . *Clonorchis*.

Genus *Holometra* Looss, 1899.

1899. *Holometra* Looss, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 564.

Generic diagnosis. — *Body* small, not tapering much, covered with long, sharp spines. *Intestinal cæca* end anterior to the testes. *Testes* asymetrically placed in posterior end. *Ovary* a little anterior to testes ; end of genital ducts, receptaculum seminis and Laurer's canal as in *Opisthorchis*. *Vitellaria* anterior to the intestinal cæca, lateral of the œsophagus ; coils of the uterus fill the entire body as far anterior as the acetabulum.

Type and single species : *Holometra exigua* (Mühling).

Genus *Metorchis* Looss, 1899.

1899. *Metorchis* Looss, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens. *Zool. Jahrb., Syst.*, XII, p. 564.

Generic diagnosis. — *Body* medium size or small, short compared to its width, tapering slightly anteriorly. *Spines* generally present. *Digestive organs* as in *Opisthorchis*, intestinal cæca generally extend to the posterior end. *Testes* orbicular or slightly lobed, more nearly opposite than behind each other. *Ovary*, receptaculum seminis and *Laurer's canal* as in *Opisthorchis*. Coils of the uterus more compact than in *Opisthorchis* and often extend laterally over the intestinal cæca and anteriorly beyond the acetabulum : *Vitellaria* compact extending anteriorly beyond the acetabulum.

Type species *Metorchis albidus* (Braun).

Genus *Clonorchis* Looss, 1907.

1907. *Clonorchis* Looss, On some parasites in the Museum of the School of Tropical Medicine, Liverpool. *Ann. trop. Med. Parasit.*, I, p. 138.

Generic diagnosis. — General organization as in *Opisthorchis*. *Testes dentritic*, branches extending laterally over the intestinal caeca. Excretory system Y shape, main trunk sigmoid, lateral trunks unite with main trunk somewhat below its anterior end.

Type species *Clonorchis sinensis* (Cobbold, 1875).

Genus *Amphimerus* Barker, 1911.

For a description of the genus see p. 535 of the present paper.

KEY TO THE SPECIES OF THE GENUS *AMPHIMERUS*

1. Testes generally lobed 2
   Testes generally simple, oval . . . . . *A. oralis* (p. 536).
2. Coils of uterus with moderate development 3
   Coils of uterus enormously developed . . . *A. speciosus* (p. 539).
3. Number of acini in post-ovarial portion of vitellaria frequently four 4
   Number of acini in post-ovarial portion of vitellaria never more than three
   Break in line of acini moderate . . . *A. pseudofelineus* (p. 538).
   Break in line of acini indefinite . . . . . *A. norerca* (p. 538).
4. Post-ovarial acini often four.
   Break in line of acini very marked . . . *A. interruptus* (p. 537).
   Break in line of acini moderate . . . . . *A. lancea* (p. 537).

Genus *Opisthorchis* R. Blanchard, 1895.

For a description of the genus see p. 540 of the present paper.

KEY TO THE SPECIES OF THE GENUS *OPISTHORCHIS*.

1. Body not covered with spines 2
   Body novered with spines.
   Found in the liver of Fish . . . . . *O. piscicola* (p. 546).
   Found in the liver of Mammals . . . . *O. caninus* (p. 543).
2. Suckers unequal, uterus well developed 3
   Suckers equal, uterus poorly developed . . *O. viverrini* (p. 547).
3. Ovary not multilobate. 4
   Ovary multilobate.
   Oral sucker larger than acetabulum . . . *O. simulans* (p. 546).
   Oral sucker smaller than acetabulum . . *O. longissimus* (p. 545).
4. Oral sucker larger than the acetabulum 5
   Oral sucker smaller than the acetabulum.

Found in the liver of Mammals . . . . *O. tenuicollis* (p. 547).
Found in the liver of Birds . . . . . *O. Entzi* (p. 544).

5. Oral sucker larger than the acetabulum.
Found in the liver of Mammals . . . . . *O. felineus* (p. 542).
Found in the liver of Birds . . . . . *O. geminus* (p. 545).

It affords me great pleasure to here acknowledge my indebtedness to Doctor W. S. Nickerson and Professor H. F. Nachtrieb of the University of Minnesota for the loan of specimens of *Amphimerus oralis*, also to Doctor B. H. Ransom, Chief of the Division of Zoology, Washington, D. C., for the loan of specimens of *Amphimerus speciosus*. My best thanks are due Professor Henry B. Ward, formerly the Director of the Zoological Laboratory of the University of Nebraska and now Director of the Zoological Laboratory of the University of Illinois, at whose suggestion and under whose direction this investigation was undertaken and without whose kind cooperation in every way especially in the generous loan of specimens of *Amphimerus pseudofelineus* and *Amphimerus oralis* and in the free use of his private library, this investigation could not have been completed.

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EXPLANATION OF PLATES

Figs. 1 to 9 plate XVII and figs. 2, 3, 5, 6, and 7, plate XVIII were made with a camera lucida from original stained and mounted specimens; the remaining figures were made with a pantograph from the original of the authors in the sources indicated under the explanation of each figure.

Explanation of Abreviations

Ac, Acetabulum; *Es*, Œsophagus; *Ex. P.*, Excretory pore; *G. P.*, Genital pore; *I.*, Intestinal cæca; *L. C.*, Laurer's canal; *Ov.*, Ovary; *O. S.* Oral sucker; *P. B.*, Pharyngeal bulb.; *R. S.*, Receptaculum seminis; *S. G.*, Shell gland; *T.*, Testis; *Ut*, Uterus; *Va*, Vagina; *V. D.*, Vas deferens; *V. E.*, Vas deferens; *V. Dt.*, Vitelline duct; *V. G.*, Vitelline gland.

The degree of magnification is indicated in most cases by a vertical line 1 mm in length at the side of each figure.

Plate XVII

Fig. 1. — Ends of the genital ducts of *Amphimerus pseudofelineus* Ward.
Fig. 2. — Spinelets in the cuticula of *Amphimerus pseudofelineus* Ward.
Fig. 3. — Eggs of *Amphimerus pseudofelineus* Ward.
Fig. 4. — *Amphimerus pseudofelineus* Ward, ventral view.
Fig. 5. — Spinelets in the cuticula of *Amphimerus ovalis* Barker.
Fig. 6. — *Amphimerus ovalis* Barker, dorsal view.
Fig. 7. — Ends of genital ducts of *Amphimerus ovalis* Barker.
Fig. 8. — Eggs of *Amphimerus ovalis* Barker.
Fig. 9. — Posterior portion of *Amphimerus ovalis* Barker showing four vitelline glands on the right side.

Plate XVIII

Fig. 1 — *Amphimerus interruptus* Braun, after Braun (1902 : 163, table I, fig. 2).
Fig. 2. — *Amphimerus speciosus* Stiles and Hassall, ventral view. Orig.
Fig. 3. — *Opisthorchis felineus* (Rivolta), ventral view. Original.
Fig. 4 — *Amphimerus lancea* Diesing, ventral view, after Weski (1900 : 382).
Fig. 5. — Spinelets in the cuticula of *Amphimerus speciosus* St. and H.
Fig. 6. — Eggs of *Amphimerus speciosus* St. and H. Original.
Fig. 7. — Eggs of *Opisthorchis felineus* (Rivolta). Original.

Plate XIX

Fig. 1. — *Opisthorchis simulans* Looss, from *Anas penelope*, after Looss, (1899 : 785, tab. XXIV, fig. 1).
Fig. 2. — *Opisthorchis longissimus* von Linstow, after Stiles and Hassall (1896 : 153, fig. 4).
Fig. 3. — Connections of the internal female organs of *Opisthorchis simulans* Looss, after Looss (1896 : 259, plate IV, fig. 30).
Fig. 4. — *Opisthorchis geminus* Looss, from *Anas boschas fera*, after Looss (1899 : 785, tab. XXIV, fig. 2).

Plate XX

Fig. 1. — *Opisthorchis noverca* Braun, after McConnell (1876 : 344, fig. 1).
Fig. 2 — Eggs of *Opisthorchis noverca* Braun, after McConnell (1876 : 344, fig. 3).
Fig. 3 — Eggs of *Opisthorchis noverca* Braun, after McConnell (1876 : 344, fig. 2).
Fig. 4. — *Opisthorchis tenuicollis* (R.), after Braun (1893, fig. 4) (plate published separately).
Fig. 5 — *Opisthorchis caninus* Barker, after Lewis and Cunningham (1871 : 168, fig. 4).
Fig. 6. — Spinelets of *Opisthorchis caninus* Barker, after Lewis and Cunningham (1871 : 168, fig. 1).
Fig. 7. — Eggs of *Opisthorchis caninus* Barker, after Lewis and Cunningham (1871 : 168, fig. 3).
Fig. 8. — *Opisthorchis viverrini* Poirier, after Poirier (1886 : plate III, fig. 1).
Fig. 9. — Egg of *Opisthorchis viverrini* Poirier, after Poirier (1886 : plate III, fig. 2).
Fig. 10. — Central portion of female organs of *Opisthorchis viverrini* Poirier, after Poirier (1886, plate III, fig. 3).

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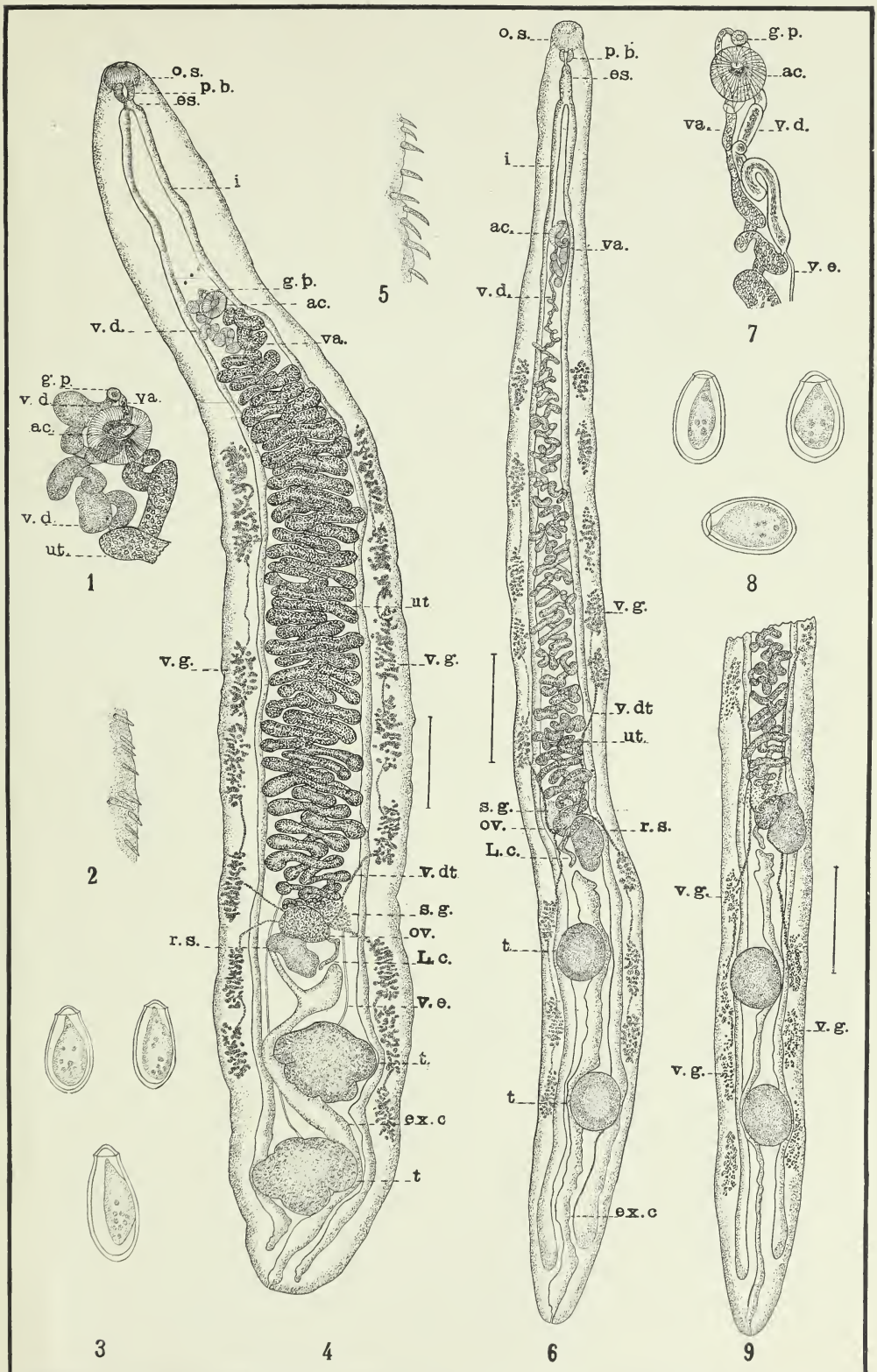

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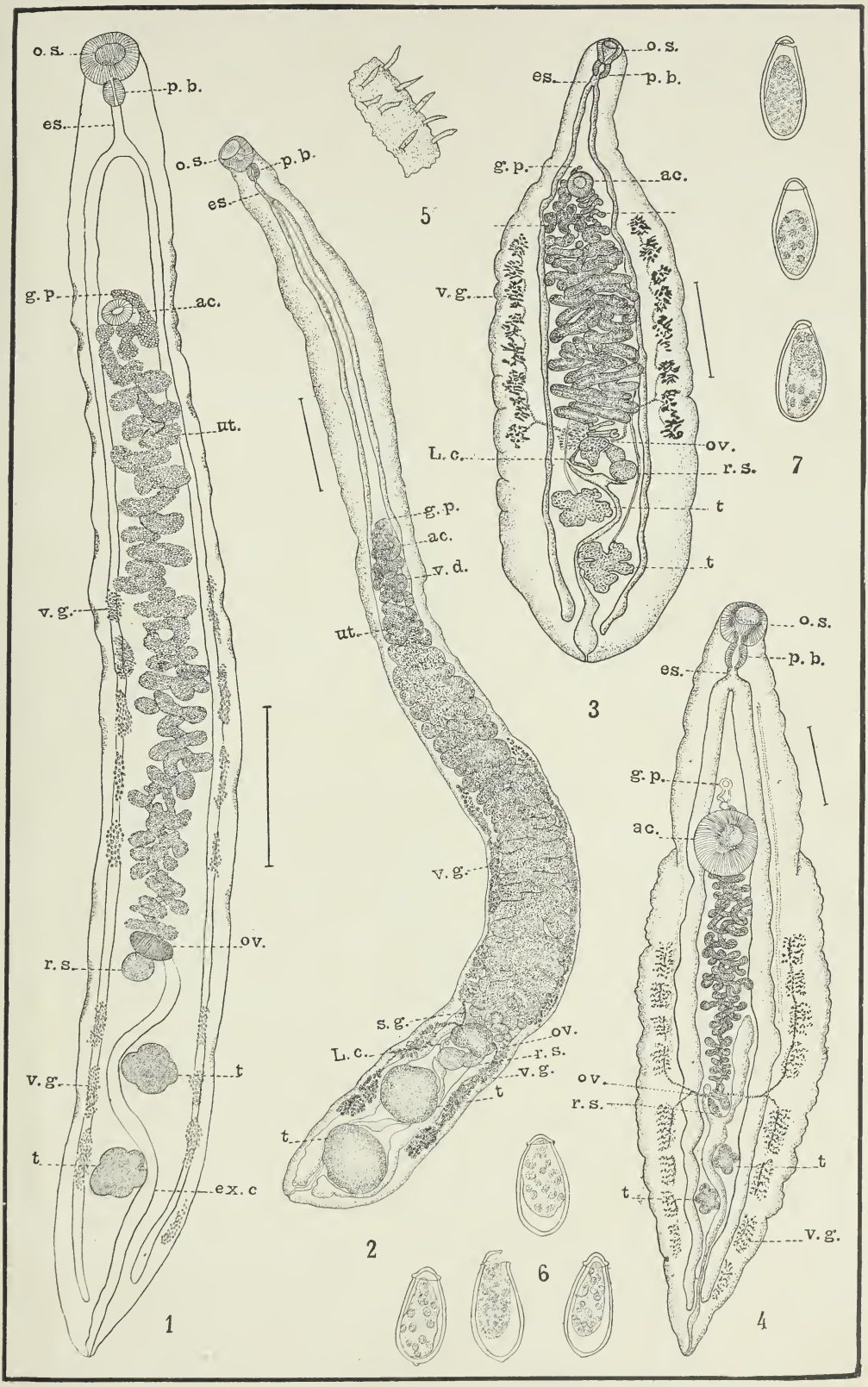

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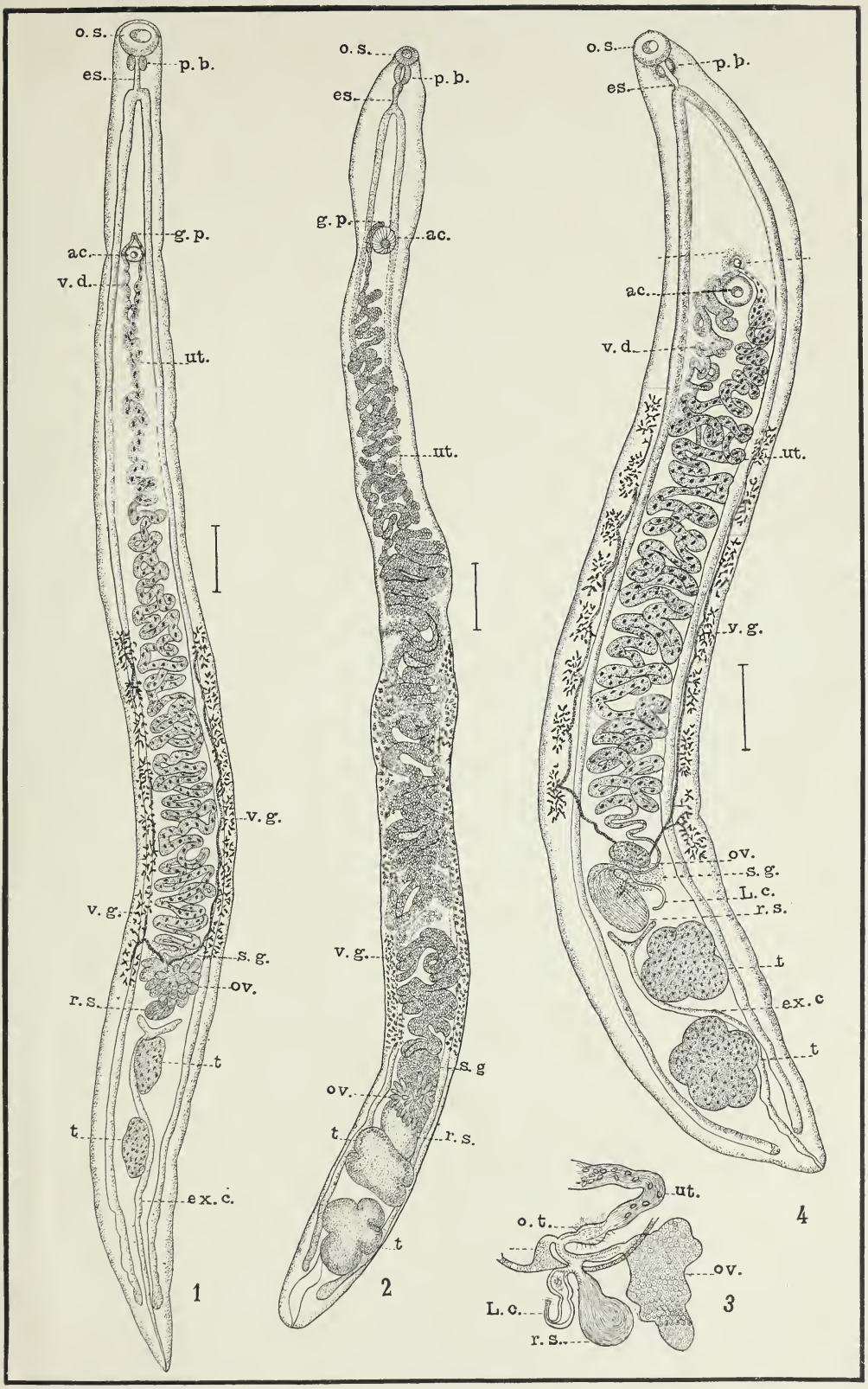

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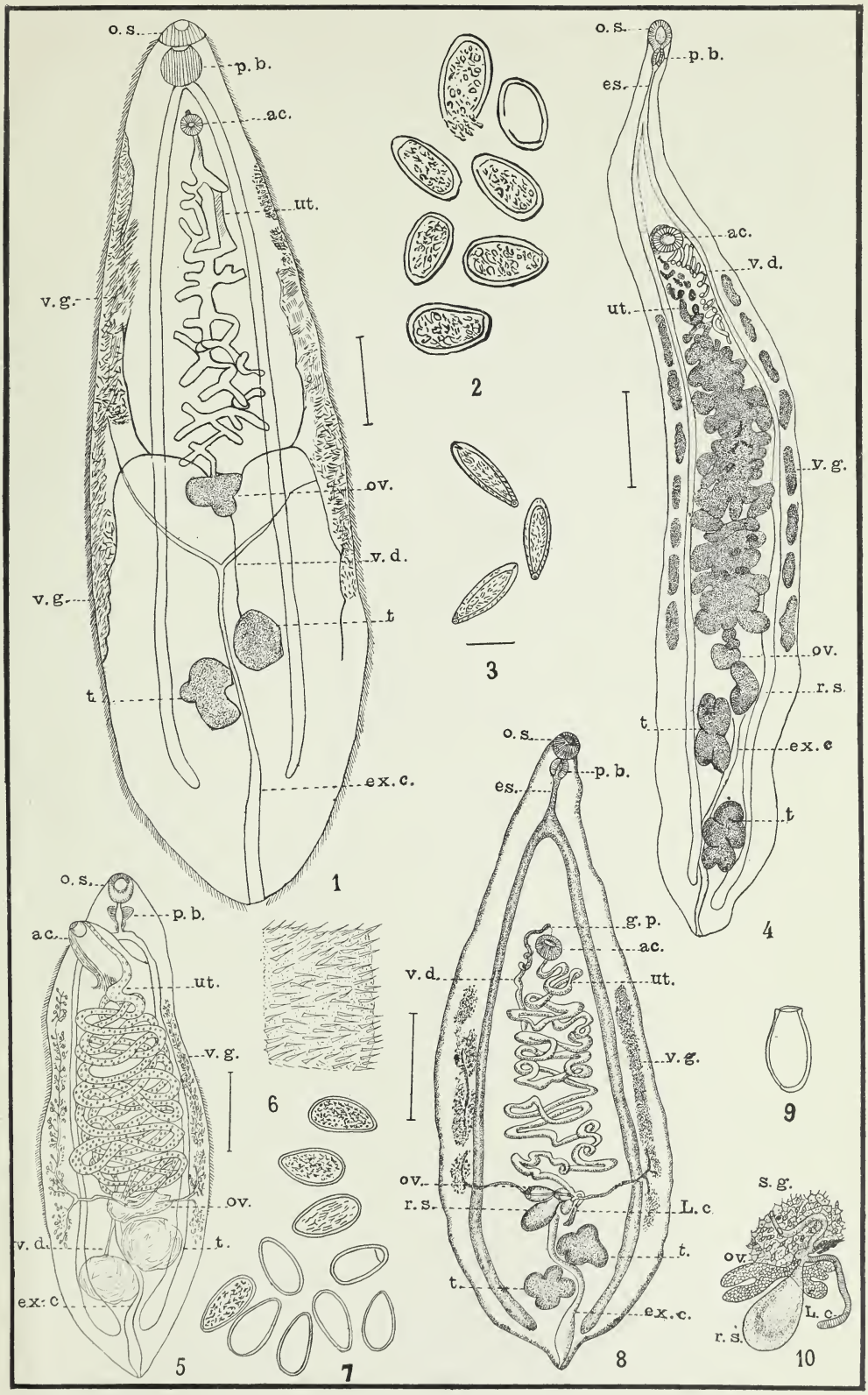

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